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Popular Science®

The **What's New** magazine

**Tough new
entry locks**
to guard your home

FIBER OPTICS
start a telephone
revolution as
threads of light
replace copper wire

**SOLAR GOES
UNDERGROUND**
in new house designs

Three new
HOME COMPUTERS



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1980 Ford: America's best MPG Van!

Ford's out front in van design—and in van economy. 1980 mileage ratings are the best of any van. And maximum estimated highway cruising range is hundreds of miles longer than others. For comfort, payload, fuel economy, look into Ford vans. Ask your Ford Dealer about Ford's Extended Service Plan.

Best mpg ratings

18 EPA EST* **26** HWY. EST*

Standard 4.9L (300 CID) Six with optional overdrive transmission.

Longest estimated range

722 EST. MILES* **1,043** EST. HWY. MILES*

Std. 22.1-gal. tank plus opt. 18-gal. auxiliary tank on 138-in. wb. Total: 40.1 gals.

*Compare these estimates with others. Your mileage and range may differ depending on speed, distance and weather. Actual highway mileage and range will probably be less than estimated. California estimates lower.



Dick Butkus
NFL Hall of Fame

Ford: out front in van design.



Drive in comfort. Ford's engine is out front—for easy move-around room. Plenty of leg and stretch-out space!



Parcel Vans!

Available with 12- or 14-ft. body. GVWR's to 4,535 kg (10,000 lbs.).

Big Super Vans! There's 20 more inches inside length over regular 3,505-mm (138-in.) wheelbase Econoline Vans.



FORD

FORD DIVISION



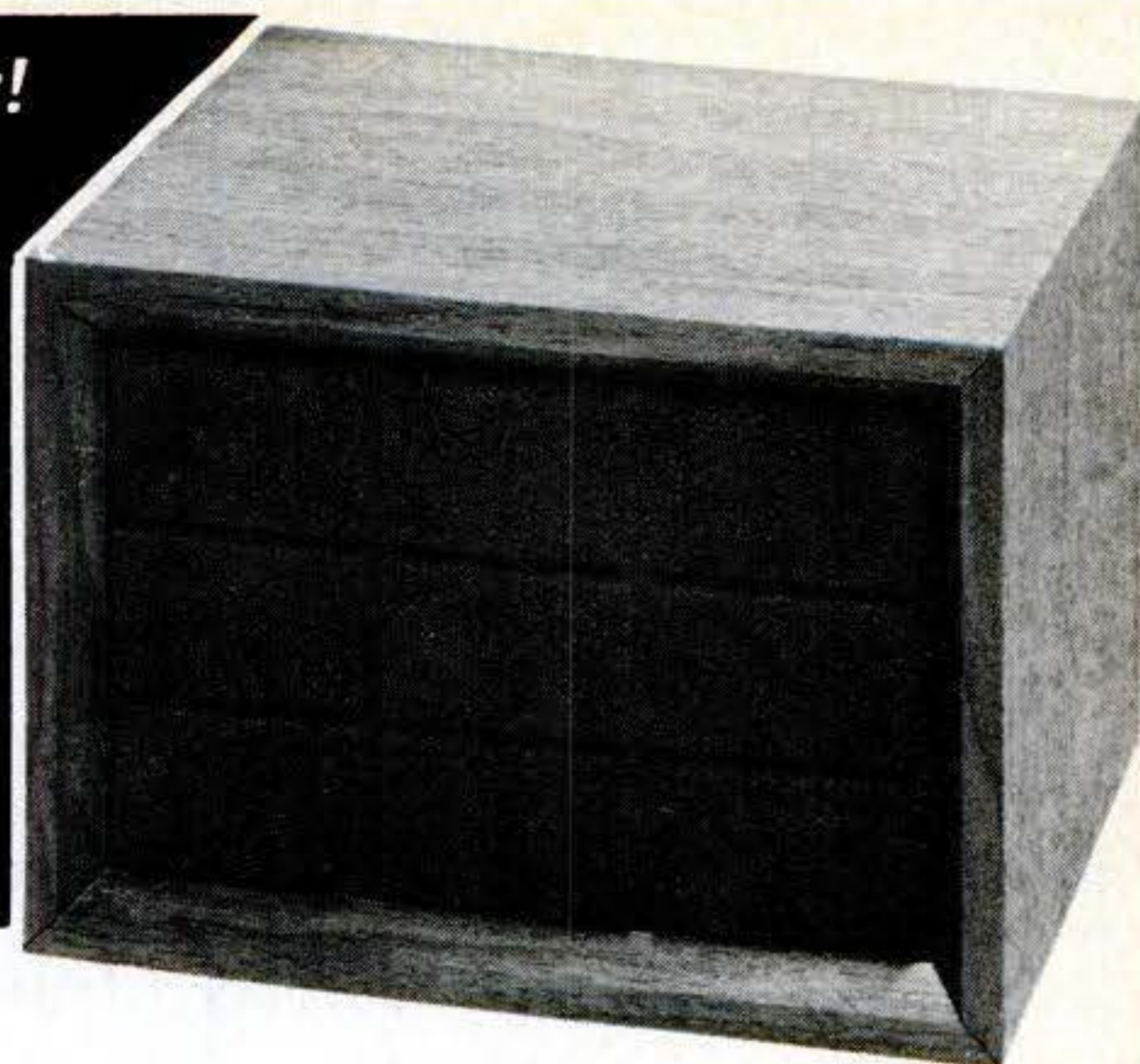
Not Just Another Limited Area Motion Detector!

guardex™

Protects Every Square Inch Of Your Building

Turns On Lights Automatically

Powerful Electronic Siren



Low Cost Computerized Burglar Alarm System Home - Office - Business

The Guardex 8000 Alarm System is walnut grained and disguised to look like a small stereo speaker (6³/₄" x 9³/₄" x 8") and weighs less than 6¹/₂ pounds.

NO INSTALLATION

Just plug the Guardex 8000 alarm system in, make several simple control adjustments to suit your particular building and it works! There are no other wires to run. This totally self-contained burglar alarm can completely seal off every square inch of the surface of your building. It protects doors, windows, and what most alarms miss...your roof, walls and floors.

HOW CAN ONE SMALL COMPUTER PROTECT MY WHOLE BUILDING?

Guardex 8000 Alarm System works on the principle of audio discrimination. This, put simply, is the process of electronically separating normal everyday sounds, such as voices, telephones, etc. from break-in type noises such as breaking glass, prying metal, or forcing a door open. The Guardex 8000 protects one story homes and offices up to 2000 square feet and open commercial buildings up to 10,000 square feet. The Guardex 9300 with wireless remote sensor capability is available for multi-story homes and offices or single story with more than 2000 square feet. Call the factory for more detailed information.

TURNS ON LIGHTS AUTOMATICALLY

When the first break-in type sound is detected, the system will instantly turn on lights, radio, or other electronic equipment that you have plugged into the back of the alarm. These lights or other equipment will remain on for a period of five minutes, then automatically turn off.

POWERFUL ELECTRONIC SIREN

The Guardex 8000 alarm is equipped with a loud built-in siren. If during the five minute period the lights or other electronic equipment has been activated, a second break-in sound is detected, (it can be only a second or two after the first break-in sound) the built-in siren will start blasting for 90 seconds. At the end of approximately 90 seconds the siren will shut off and the alarm listens again. If another break-in sound is heard, the siren will come on for another 90 seconds. If no other break-in sound is detected, the siren will stay off and at the end of the five minute period the lights will shut off and the alarm instantly resets.



The rear control panel contains two standard AC plug receptacles for a table lamp, spot lights, radio, etc.; terminals for connecting optional outside siren and back-up battery (not included); entry delay time control and sensitivity control.

EXIT AND ENTRY DELAY

The Guardex 8000 alarm has a built-in exit delay allowing you approximately one minute to lock up and leave the building before the alarm is armed. When you enter your building you may find that just your normal entering sounds activate the siren. You may delay it from starting for up to 30 seconds by turning up the siren entry delay control.

BATTERY BACK-UP

Burglars rarely cut power. However, to give you total protection from a burglar and possible power failure, our alarm has provisions for a battery back-up. (Batteries not included). 12 volt lantern batteries are available at most hardware stores.

THE BURGLARY PROBLEM

The F.B.I. statistics show that at the present rate, one out of every four Americans are going to be burglarized. That is not a very pleasant fact, but it is true. You have a greater chance of being burglarized than being a victim of a fire or automobile accident. The time is now to help protect yourself and your valuables with a Guardex 8000 alarm system.

OUTSIDE SIREN

The Guardex 8000 alarm is equipped with a loud, built-in siren, but if you desire an additional siren to mount outside or in an area away from the main alarm, they are available with 50 feet of wire for \$24.95. (Connecting terminals are provided on the back of the alarm).

30 DAY NO RISK TRIAL

This is your opportunity to purchase an alarm system directly from the factory for only \$199.95. Try it in your home or business for thirty days without risking one cent. Put our Guardex 8000 alarm to your own test. See for yourself! It will protect every window and door from break-in. If you are not completely satisfied, return the alarm within 30 days for a complete refund. To order your Guardex 8000 alarm, CALL TOLL FREE to charge your credit card or send your check to Guardian Electronics, Inc. in the amount of \$199.95. If you want the optional outside siren, add \$24.94. (California residents add 6% sales tax.)

(If you require more information, call during California business hours, Monday - Friday)

Dealer Inquiries Invited

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MAY 1980
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MONTHLY®

The **What's New** magazine

HIGHLIGHTS OF THIS ISSUE

Tough entry hardware to guard your home

Keep burglars out—and your valuables in—by reinforcing door security. PAGE 128

Solar goes underground in new house designs

Our gallery of sub-earth dwellings shows they make passive-solar sense. PAGE 82

Spring home-improvement: special section

25 pages of projects and hardware to spruce up your home. STARTS PAGE 115

Fiber optics start a communications revolution

Glass threads can carry thousands times more information than copper wires. PAGE 99

Three new home computers

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Sears Armadillo FencingTM is so tough it fights off rust, corrosion and weather.

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Most chain link fence frameworks are hot-dipped galvanized for protection against corrosion. But ArmadilloTM has that, and more. It's triple coated!

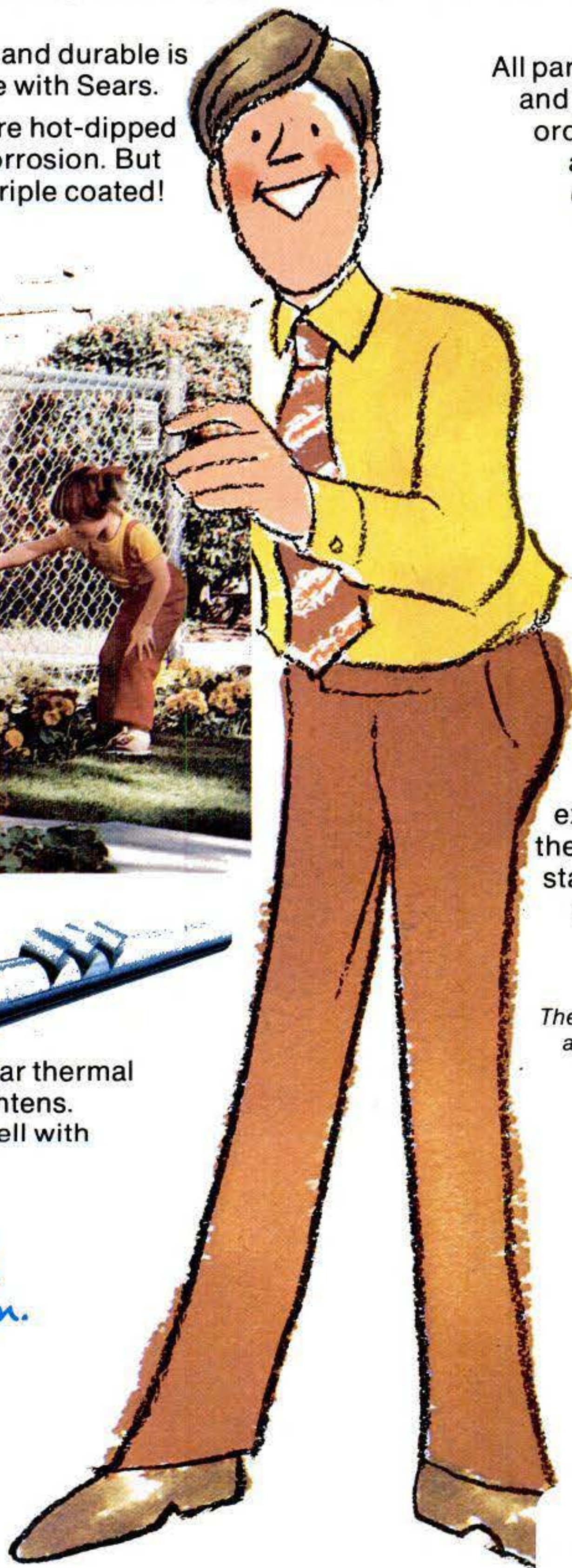


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First comes a galvanized coat of smooth zinc. Then a chromate coating for added protection. And, finally, a clear thermal acrylic coating that bonds and brightens. The result is an Armadillo-tough shell with an even, long-lasting luster.



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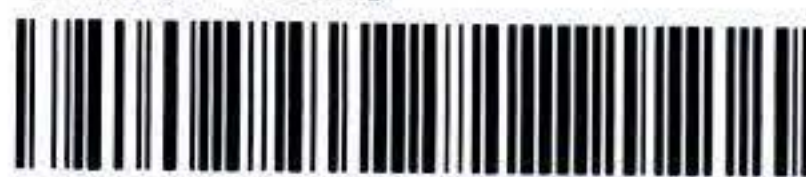
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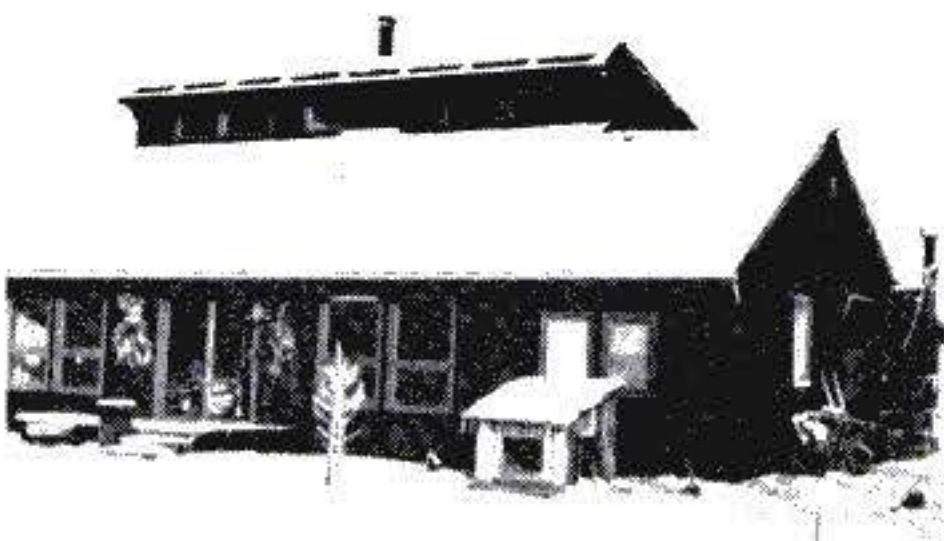
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PS READERS TALK BACK

Address letters for this column to: **Readers Talk Back**, 380 Madison Ave., New York, N.Y. 10017. Because of the large volume of mail, we are unable to acknowledge unpublished letters.

No propane on the prairie



Two extreme winters in central Illinois have been the proving ground for our house. It combines passive-solar features with wood heat, naturally circulated by an underfloor plenum, an idea gleaned from a POPULAR SCIENCE article on Charles Grant's house ["Wood Stove Heats His Whole House—Without Ducts," Oct. '76]. We have no difficulty maintaining a comfortable year-round temperature even though we burn only 1½ cords of wood a winter and have insulated only to standard recommendations.

Now we sit comfortably on the prairie and chuckle as the propane truck passes us by. Keep up the good work.

J. Randall and Christina Owings
 Warrensburg, Ill.

And is that a passive-solar dog house we see out front?

Low-temperature collector

We enjoyed reading your February "Adventures in Alternate Energy" on the Palmer solar house. We can also attest to the advantage of operating solar-heating systems at very low temperatures. Our patented system, which uses a flat-plate collector with the water flowing down the underside (see diagram), has been able to provide 50 percent of our hourly heat needs with water storage temperatures of no more than 85 degrees F with outside temperatures in the teens.

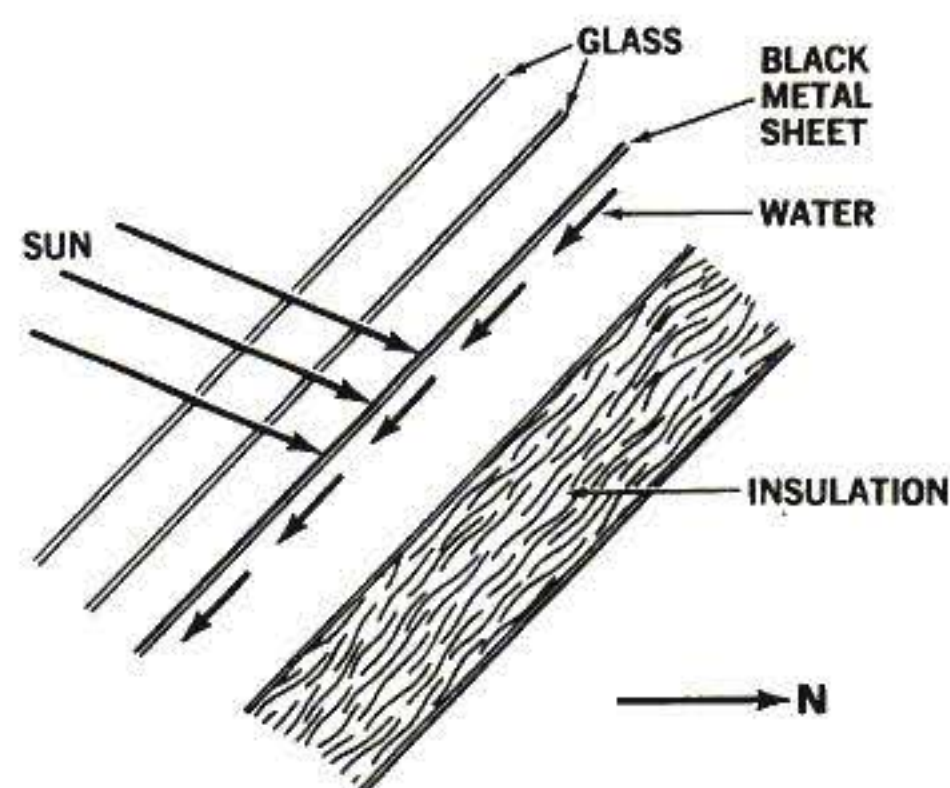
It's unfortunate that most of the "ex-

perts" seem to design high-temperature solar-heating systems which then perform with low efficiency. Of course, Harry Thomason has been aware of the advantages of low-temperature operation for 20 years, but the "experts" (including the DOE) usually refuse to acknowledge the merit of his work.

Our system has provided 82 percent of our heating needs for a mild December and more than 90 percent for November. It appears that it will provide a high percentage of January's needs with water temperatures rarely exceeding 100 degrees F.

Haven Noble
 Enterprise Design Inc.
 Mt. Pleasant, Iowa

Readers wanting more information about Mr. Noble's collector should contact Fuel Control Corp. (7661 Washington Ave. South, Edina, Minn. 55435), which is marketing the system; the telephone number is 800-328-6335. For details of Mr. Thomason's collector, see PS, Jan. '77: "Trickle-Down Collectors—How Efficient?"



Alcohol power

In your excellent article on alcohol as a motor fuel [PS, Mar.], concern is expressed that the process of making alcohol loses energy: It takes 130,000 Btu of input energy to produce alcohol having 84,000 Btu of energy content, says one

Continued

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PS readers talk back

[Continued]

expert you quote. "It's kind of like a businessman who spends \$10 to make \$5." This seems to me a dangerous and short-sighted view of the possibilities for alcohol production. There is no resemblance to spending \$10 to make \$5, unless we are going to use a gallon of petroleum to make the gallon of alcohol—which we ought not do. We would instead use some other fuel, domestically available, to supply the heat necessary for making the alcohol.

For at least 75 years, the electric-utility industry has been growing and universally accepted, as it supplies a uniquely versatile form of energy. But it throws away two times as much energy as it delivers at the end of the wire. When energy is converted from one form to another, there is always loss.

The inefficiency of the process is accepted because we are upgrading the energy to a more useful form. That's what one would be doing in making alcohol from coal or nuclear energy. We need to make enough alcohol to be self-sufficient and independent. Never mind the cost—it's within striking distance now and will come down. But we must not discard the idea because its use would result in a net loss of energy.

Donald R. Meier, Morristown, Tenn.

I found it distressing that your article "Alcohol Fuels" evaded any mention of the useful byproducts of grain-produced alcohol. I don't have exact figures as to the percentage of residue left for feeding livestock, but it is substantial and of good quality. Alcohol from grain is a big plus in many ways:

- We are getting two or more uses from the grain.
- The American farmer raises much more grain than the U.S. can use.
- We could eliminate the bureaucratic expenses of setting up farm programs and subsidizing idle acres.

These and other advantages certainly should be considered if we are to arrive at a fair conclusion as to what is best for America.

M. K. Yeager, Lodgepole, Neb.

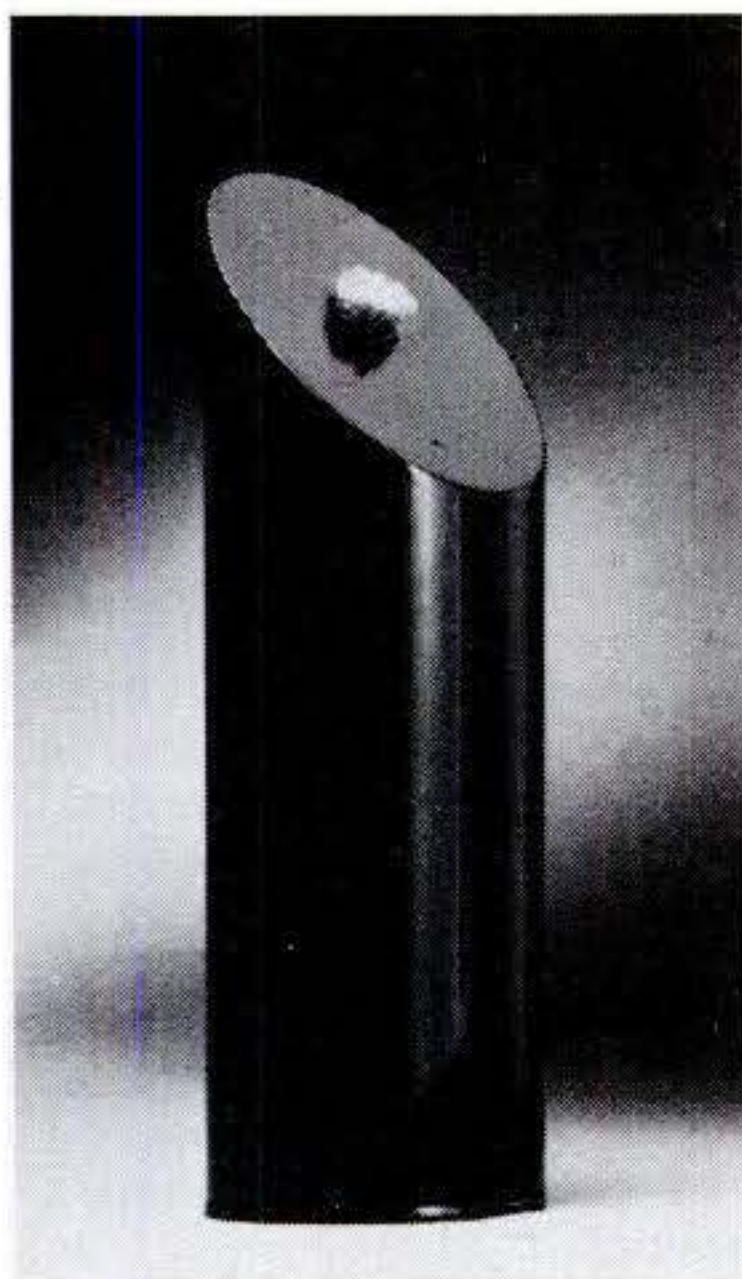
Einstein: theory into practice

C. P. Gilmore's article in the December '79 issue "After 63 Years, Why Are They Still Testing Einstein?" was most interesting and most complete—except for one experiment.

Suppose one were to adjust an atomic clock to a given clock-system standard on Earth and then place it in orbit. One would expect the frequency to change (as in Vessot's experiment) for two reasons: first, because the velocity of the satellite produces a frequency shift, and, second, because the change in gravity field would also shift the frequency.

To do the experiment, one needs a clock that will operate in one of two modes. Either it must run throughout the experiment, as did Vessot's, or it can be off during the launch and be started up when in

Continued



Miracle Fuzz

A new space-age invention and the same effect as lightning combine to create the world's first home oxygen regeneration system.

The new Energaire ionized oxygen generator will make a handsome addition to any desk.

You need oxygen to live. You can live without food for 60 days, without water for seven days, but without oxygen, you won't make it past two minutes.

That small piece of fuzz located on top of the cylinder shown above emits negatively-charged electrons which attach themselves to molecules of oxygen, thus creating ionized oxygen.

You are already familiar with ionized oxygen if you've smelled the air after a thunderstorm. You feel great, revitalized, and alert. The lightning from the storm adds a small negatively-charged electron to each oxygen molecule in a process called ionization.

SCIENTISTS DISCOVER

Scientists discovered that air quality can actually affect your moods, your feelings and your sense of well being. Air that is positively charged caused people to be depressed, moody and tired. Negatively-charged air made people feel good. We have all experienced air that is positively charged in air-conditioned buildings or in a polluted environment.

Scientists looking for a way to turn positively charged air into negatively charged air developed the negative ion generator—a product that produces negatively charged particles that attach themselves to air molecules and thus create the same fresh feeling you get after a thunderstorm.

The new space-age product shown above is an ionized oxygen generator called the Energaire air purifier. The copper mesh fuzz on top of the unit is one of the secrets of the system.

Although it has no moving parts, you can actually feel a wind of ionized oxygen produced from the fuzz which spreads to fill an average-sized room in one minute.

CIGARETTE SMOKE TEST

To show the dramatic effect of ionized oxygen, you can take the Energaire, blow cigarette smoke into a clear bowl, and hold the bowl inverted over the system. The smoke will vanish. The charged oxygen particles appear to dissolve the smoke particles, precipitating them from the air.

In a room, the Energaire air purifier surrounds you with these oxygen ions and cleans and purifies the air so that even in a smoke-filled room, you will be breathing cleaner, country-fresh air all day long.

WALL TEST

Take our unit and place it next to a wall. Also

put a large piece of paper on the wall. Within a few days notice how black the paper gets. That black film is finite carbon particulate matter—the same pollutants you would normally breathe and that would pass through most air filters. By placing the unit in the center of a room or away from a wall, that same matter falls to the ground as dust.

A trip into the mountains exposes you to nature's freshly ionized oxygen. The Energaire produces this same effect. It will clean your room of odor-causing bacteria and stale, musty, or smoky air.

Ionized oxygen should not be confused with ozone. Ozone has a molecular formula of O_3 , whereas the molecular formula for ionized oxygen is O_2 with a negatively-charged ion.

DON'T BE CONFUSED

After we announced the Energaire last year, many companies came out with their own ion generators. We purchased a unit from each company and tested them at an independent laboratory. The results are shown below:

Name	*Ions	Price
Energaire	438,000	\$79.95
Omega 700	63,000	245.00
AirCare	72,000	149.95
Modulion	75,000	79.95

**Measurements indicate total number of ions per cubic centimeter per second at one meter. These figures may vary by plus or minus 10%.*

Note: One unit not mentioned above produced no ions and actually produced ozone or several times the maximum ozone concentration allowed by federal government standards.

USED IN HOSPITALS

Many hospitals are now using ionized oxygen systems in their operating rooms and burn centers. Their units not only purify the air, but they also eliminate pollen and other irritants.

Working in a clean air environment, you think clearer, are more alert, and you function better. The Energaire is actually a miniature lightning machine. The minute you plug it in, energy is converted into ionized oxygen. This efficient system uses one watt of power or less than a penny per day to operate, so you leave it plugged in continuously.

We are so impressed with the pleasant effect of Energaire that we urge you to personally test it yourself in your home or office. Order one at no obligation. Put it by your desk, or in any room where you spend a great deal of time. See if it doesn't rid your room of odor-causing bacteria and stale, musty or smoky air. Try the smoke and paper tests mentioned in this advertisement.

SLEEP FASTER

At home, use the Energaire by your bed and see how country-fresh air allows you to sleep easier, deeper, and more relaxed.

You should notice the difference within one day—especially in a work environment. But use the Energaire for a full month. Then, if you do not feel totally convinced of the positive effects of ionized oxygen, return your unit for a prompt and courteous refund.

The Energaire is manufactured by the Ion Foundation, a leading ion research and development company.

Service should never be required, but if it is, there's a prompt service-by-mail center as close as your mailbox. JS&A is America's largest single source of space-age products—further assurance that your modest investment is well protected. The Energaire measures 9" high by 3" in diameter and weighs 24 ounces.

To order your Energaire ionized oxygen generator, send \$79.95 plus \$3.00 for postage and handling (Illinois residents, please add 5% sales tax) to the address shown below or credit card buyers may call our toll-free number below. We will send your Energaire ion generator complete with 90-day limited warranty on the electronics, a five-year warranty on the fuzz, and complete instructions.

Let space-age technology revitalize your life with the world's first home ionized oxygen generator. Order one at no obligation today.

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PS readers talk back

[Continued]

orbit. To be effective, the clock for the second experiment must have a good reproducible characteristic (i.e., it must start up at the same frequency every time it is turned on). The cesium-beam-tube standard has such a reproducible characteristic.

This experiment was run as part of the Global Positioning System (GPS) program in 1977 by the Naval Research Laboratory, in connection with the Navigation Technology Satellite No. 2 (NTS-2). The frequency change expected was 445 parts in 10^{12} ; the frequency change measured was 442.5 parts in 10^{12} . The difference, 2.5 parts in 10^{12} , is indicative of the reproducibility of the cesium-beam standard.

This experiment was important in that it showed the clock variation directly. It also shows that the relativity theory, once so difficult to verify, is now about to enter everyday life in the field of navigation. From a brilliant scientific thought process near the beginning of the century comes an engineering tool for the '80's.

Roger L. Easton
NRL GPS Program Manager
Naval Research Laboratory
Washington, D.C.

Inside storm windows —a shady thought

Your article "Storm-Window Kits" [PS, Feb.] correctly pointed out the increased thermal efficiency and reduction of air infiltration possible with such windows. The story was well timed, since the market is fast becoming saturated with these products.

But I would like to ask if the PS staff ever tried to open or close the shade on a window fitted with an inside storm window. I think you would find it impossible unless the shade is removed from its conventional position within the window frame and reinstalled on the room side of the storm window. This drawback should be pointed out to your readers.

Richard Couture, Somersworth, N.H.

Corrections: In the April "Motorcycling" column, we inadvertently left out the name of the manufacturer of the GS 850, the motorcycle ridden by Ray Hill for 8000 miles. It's made by Suzuki.

In the February issue, in the chart "PS Buyer's Guide to Mid-Priced Imports" (page 96), the 2.6-liter engines of the Dodge Challenger and Plymouth Sapporo are rated at 70 hp at 5200 rpm. The correct rating is 105 hp at 5000 rpm.

In February's "What's New in Home Improvement," the wrong prices are given for the "Energy Computer." A Master-Mind unit for a gas-fired boiler costs approximately \$200, including installation; the type for an oil-fired tankless boiler is about \$300, installed.

Another price error appears in "Anti-Theft Devices" [PS, Jan.]. The Hi Security steering-column lock available from Lock Technology Corp. is \$65, without installation.

PS

Heart Computer

Your heart can tell you three things that can help you live longer and stay healthier. The rest is up to you.

JS&A has never offered a pulse meter. And for good reason.

If you've ever used one, you'll quickly discover that your heart does not beat like a clock. It's irregular. It might beat at 40 beats per minute for one instant and at 120 the next. Since most pulse meters measure each beat as it occurs, you never feel confident that you're getting a very good reading.

We also considered size. Each pulse meter we examined was large or cumbersome and awkward to carry or store.

WE WAITED

We waited a few years. In the meantime, we discovered three ways your heart (through your pulse) helps you monitor your health.

Pulse Rate Your pulse rate can tell you if you are getting enough oxygen throughout your body. A high pulse rate indicates that your heart must pump faster to supply that oxygen and may indicate poor physical condition.

Target Zone Your pulse can tell you if your heart is beating fast enough during exercise. There's an area called the "Target Zone." Below this level, you're not exercising hard enough to do your heart or respiratory system any good. Above this level, you can be dangerously over-exerting yourself.

Cardiac Recovery Time The time it takes for your pulse rate to return to normal after you've exercised is the real measure of whether or not your exercise program is doing you any good. This time can be as healthy as one minute or as poor as several minutes.

The three things we learned convinced us that the ideal pulse meter must have the following features:

1. It must measure a series of heart beats and simultaneously compute the average to avoid the strange readings from irregular heart beats.

2. It must be small enough to use while exercising.

3. It should have a timing capability to determine the Cardiac Recovery Time.

It wasn't until a small Utah medical electronic instrument company created what we feel not only provides the capabilities listed above, but excels in other areas too.

FITS ON FINGER

The unit is called the Pulsetach, and it fits right over your finger. It weighs less than an ounce and can be worn easily during most exercise programs.

The large liquid crystal display can easily be seen in normal room lighting or in bright sunlight, and because liquid crystal displays consume very little power, the readily-available watch batteries will last for years. The Pulsetach automatically turns itself off in five minutes if you forget.

The heart of the system is a powerful micro-

computer CMOS semi-conductor integrated circuit that will take up to 4 pulse beats, compute an average pulse rate, and then flash that rate on the liquid crystal display.

FINGERTIP SCANNER

The sensor consists of a Gallium Arsenide infrared light-emitting diode which scans your fingertip hundreds of times a second to determine your pulse rate. This new system is one of the most accurate and is also used in sophisticated hospital systems.

The unit also contains a quartz-controlled timing circuit which will accurately time either your exercise period or your Cardiac Recovery Time. And you can switch back and forth between the pulse and chronograph mode while you are exercising.

We realize that the Pulsetach sounds like a very sophisticated unit. And it is. But as sophisticated as it is internally, it's an extremely easy unit to operate. There are just two buttons to press which operate the pulse reading and the chronograph timing circuit. A third button engages the audio circuit.



The Pulsetach system fits comfortably on your finger while it monitors your heart and determines your Cardiac Recovery Time.

HEAR YOUR PULSE

The audio circuit simply beeps every time your pulse beeps. This feature lets you monitor your pulse by hearing it as you run or exercise and it can be shut off by pressing the button a second time. The timing circuit is quartz-controlled and extremely accurate.

The Pulsetach not only has combined all of the most advanced technology in an extremely small size, but it costs less than many other systems lacking its advanced features.

The Pulsetach can be used for joggers, athletes, all forms of exercise and even cardiac recovery patients, as it operates quite effectively with pacemakers.

REAL WORKOUT

We suggest you order a Pulsetach for our 30-day no-obligation trial. When you receive your unit, give it a real workout. Notice how simple it is to operate and how easily you



The Pulsetach will shortly become the number one selling system of its type in the nation.

can read your pulse rate. Use it to stay in your Target Zone and to determine and then improve your Cardiac Recovery Time.

Monitor your Cardiac Recovery Time. Determine your Target Zone and see if you're really exercising in that area. Then use the Pulsetach to watch those important signs slowly improve thanks to the accuracy and information you get from the unit.

By knowing the important factors that help you monitor your health, you'll feel better, exercise more effectively, and many doctors feel you'll live longer.

TWO UNITS AVAILABLE

To order your Pulsetach pulse meter, send your check for **\$119.95** plus \$2.50 postage and handling (Illinois residents add 6% sales tax) to the address below. (Allow 20 days for personal checks to clear.) Credit card buyers may call our toll-free number below.

You can also order the more expensive hospital unit that averages 16 beats and has all the features including the small size of the previous unit. It costs **\$169.95**.

We'll send your Pulsetach pulse meter complete with 90-day limited warranty and instructions which include information on determining your Target Zone, Cardiac Recovery Time and other helpful information.

Then after your test, if you're not fully convinced that the Pulsetach is the best unit of its kind, the most convenient, and the greatest value, return it within 30 days for a prompt and courteous refund including the \$2.50 charge for postage and handling. You can't lose.

Your Pulsetach is totally solid-state so service should never be required, but if it is, the manufacturer has a national service-by-mail facility backing each unit. JS&A is America's largest single source of space-age products—further assurance that your Pulsetach is backed by a substantial company.

We've waited an awful long time to jump into the pulse monitoring field. But what a great entry. Order your Pulsetach at no obligation today.

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Three new home computers

that teach themselves —
and teach you
how to use them

They're smart, they come ready to work, and one of them even talks to you

By **BILL HAWKINS**

PHOTOS BY ORLANDO GUERRA

Only two years ago, home computers were for the hobbyist: a jumble of wires, transistors, and circuit boards that came in a kit. And once the kit was assembled, there was complicated programming to master. Things have really changed since then.

Recently I've been trying three of the newest home units from APF,

Atari, and Texas Instruments (first reported on in PS, Nov. '79). They're no more complicated to hook up than a video game. The programming can be learned in just a few evenings. External pieces, such as a printer for making permanent records, are as easy to plug in as a toaster. Best of all, the

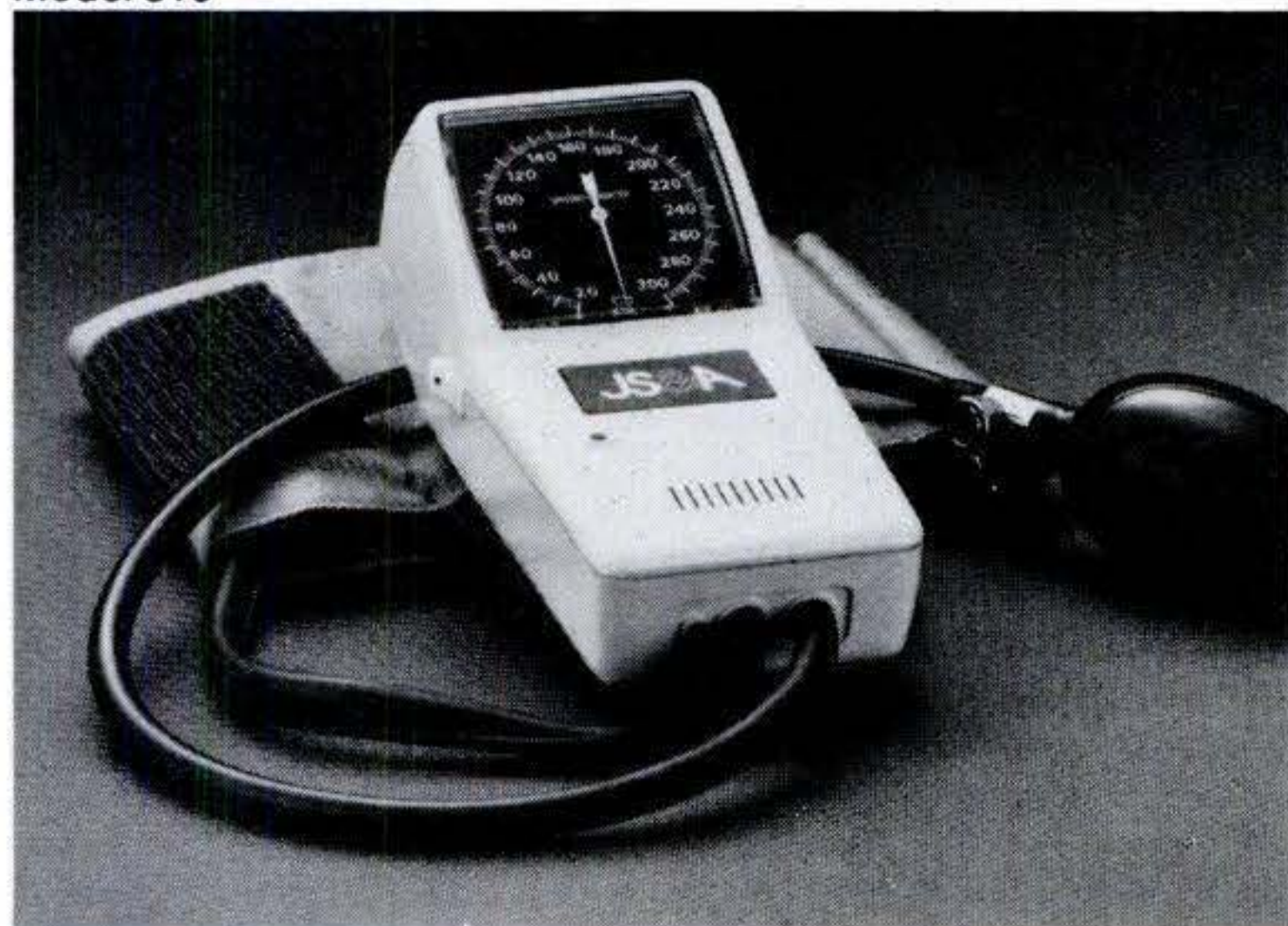
Continued



Extended Lifespan

JS&A was destined for failure when we introduced our first electronic blood pressure unit. But then a miracle happened.

Model 310



Model 410



Advertisements were starting to appear everywhere. JS&A had just introduced the world's first home electronic blood pressure unit in a massive national advertising campaign.

But something was strange. JS&A often tests its products in its catalog first before they are nationally advertised. If they sell well, we then start a national magazine advertising campaign. The blood pressure unit sold well in our catalog, but for some strange reason, it wasn't selling well in magazines.

SHOCKING DISCOVERY

And then we found the answer. A few months earlier after our blood pressure unit appeared in our catalog, our computer manager (let us call him Ralph to protect his identity) handed us a computer printout of the catalog sales results.

Scanning the results, we discovered that the blood pressure unit was the best-selling product in our catalog—far exceeding every other product by five times.

The results were so positive that we immediately placed hundreds of thousands of dollars in an advertising campaign launched in early 1978.

Just as the advertisements were starting to appear, Ralph walked into our president's office with some startling news. "There's been a mistake," Ralph said. "The computer printout was wrong. The blood pressure unit is actually our worst selling product but a computer error gave us the wrong information."

And so our president sat back and watched JS&A advertisements appearing everywhere, knowing full well that the campaign would cost his company almost the price of a new computer.

Then came the miracle. As if by plan, the American Medical Association came out with

an advertising campaign urging consumers to take their blood pressure regularly to combat hypertension or high blood pressure. Ads appeared everywhere.

The campaign revealed that there may be as many as 25 million Americans who have high blood pressure and don't know it. Simply by taking their own blood pressure and discovering hypertension early enough, Americans could be saving their lives and reducing the chances of heart attacks. Suddenly our campaign started to sell blood pressure units by the thousands.

AWARD RECEIVED

This year JS&A's president received the Extended Lifespan award for "pioneering in the distribution of home health electronic devices" by the Committee for an Extended Lifespan. In accepting the award, our president made it very clear that the award was earned as a result of a computer error and not as a result of his brilliance.

This story is painfully true. And although it may be a slight embarrassment to us, there is one aspect that is not. JS&A was indeed the company that pioneered the electronic blood pressure units and has always selected the very best units available to offer at the very lowest prices possible.

NEWEST UNIT

Our newest unit shown above is another example. The model 310 sells for only \$69.95 plus \$2.50 for postage and handling (Illinois residents, please add 6% sales tax.) You simply wrap the velcro cuff around your arm (you can even keep your shirt on) and inflate the cuff. Both an audible tone and a visible red light will indicate your systolic and diastolic readings. The system is extremely accurate, comes with a self-bleeding air valve and can be stored in a convenient carrying case that

comes with each unit.

The deluxe model 410 functions similar to the first system except that the readings are displayed in digits, and the unit also displays your pulse reading. It sells for \$139.95 plus \$2.50 per unit for postage, insurance and handling. If for any reason you are not completely satisfied with either unit, you may return it within 30 days for a prompt and courteous refund including your \$2.50 postage and handling. To order either unit, credit card buyers may call our toll-free number, or you may send your check or money order to the address below.

Both units use solid-state components, come complete with instructions and a one-year limited warranty, and should give you years of trouble-free service. If service should be required, we maintain a service-by-mail center as close as your mailbox. JS&A is America's largest single source of space-age products—further assurance that your modest investment is well protected.

If you are concerned about your blood pressure or know somebody who is concerned about monitoring his or hers, we recommend JS&A's latest units.

Incidentally, Ralph left JS&A on his own accord and bought a farm in another state. There were no hard feelings when he left. How could there be? Order your blood pressure unit at no obligation, today.

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APF Imagination Machine comes in two sections. The first is a separate video game that contains the microprocessor, memory, and video circuits. It simply rests on top of the second keyboard section. A U-shaped connector (top right) electrically connects the two. Cartridge containing the BASIC language inserts into the rear of keyboard (lower left). This slot will also accept a disk add-

on option. Cassette deck (lower right), built into keyboard, saves and retrieves your program or accepts preprogrammed cassettes from APF. Typing Tutor course, for example, gives you instructions through the built-in speaker, then tests your skill at duplicating the keys shown on the TV screen. Speed and accuracy is then scored and you're retested on weakest keys.

computers can teach themselves.

Basically, these new computers resemble each other. But with prices spread from \$600 to well over \$1000, there are important differences. Some of that is in what you get now. In other cases, your money goes for what you can add later. I found strengths and weaknesses in each machine.

Before getting into the specifics of these systems, it's important first to know the basics of what these machines offer.

Minimum gear

The brain of a computer is a tiny integrated circuit chip (microprocessor). But for that brain to do actual work, it needs more.

It needs a keyboard for entering information into the computer. To get info back out again so you can see it, the system requires a display. This can be its own (dedicated) video mon-

itor or, as it is in most cases, a standard TV set.

And somewhere between putting data in and getting it out, the computer must have a memory—more integrated circuit chips that can hold bits of information for the system to use.

Conventional memories retain information only until you switch off the power. To save programs or raw data for future retrieval, these home computers include a cassette-tape storage system—usually a standard cassette recorder that's either attached or built into the computer box.

Now the system has the hardware necessary to enter, retrieve, and save data. But computers are stupid. The final ingredient they need is intelligence—programming—to teach them what to do when asked to print out $2+2$, for example.

Using their built-in language—called BASIC—these computers con-

vert your English commands, from the keyboard, into binary numbers the microprocessor can use. Thus all you need to do is learn a few key words used by BASIC to make the system work.

Besides these minimum necessities, the new computers offer color graphics—the ability to draw “computerized” color pictures on the screen—and sound effects for creating your own electronic music.

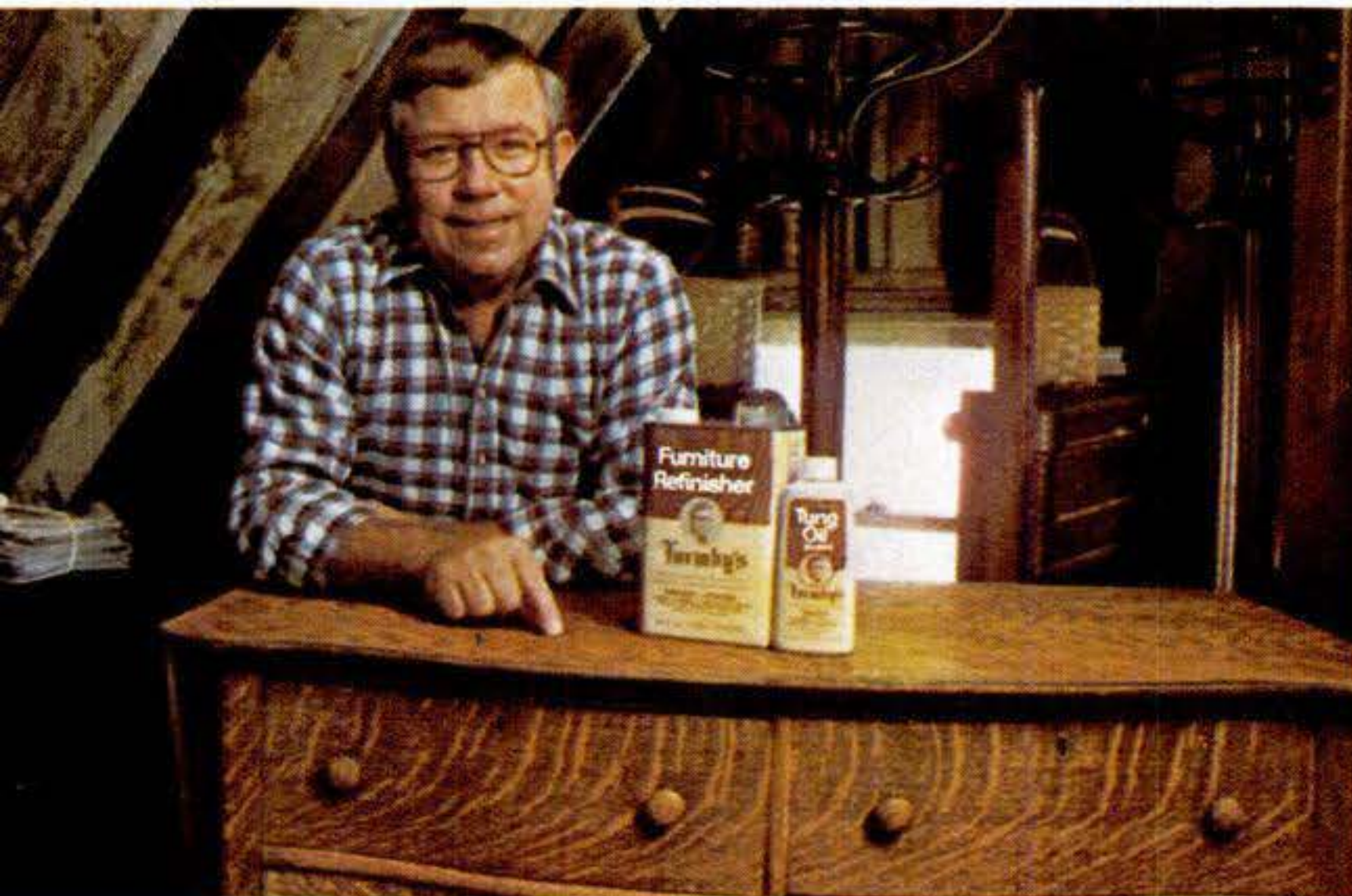
Another plus is flexibility—extremely important to the future of any computer—both in hardware and software. If you want to add a printer later, for example, you not only need a place to attach it to the computer (hardware port), but the computer must also know how to use it (software control). In that respect, these systems become quite clever.

Each contains a *monitor* program.

Continued

"You're sitting on a gold mine."

Homer Formby's guide for turning old furniture into gold. And keeping it that way.



The battered bureau. The sorry sideboard. The down-and-out desk.

Do you have any of these in your home? I'm sure you do.

Please don't give up on them. Please don't rush out to buy new furniture that's probably not made with one-tenth the craftsmanship of those old pieces.

I've developed a very special family of products to help you live with and cherish old and antique furniture. I've already shown thousands how easy it is to refinish, and how simple it is to maintain the finish on their furniture.

Don't redecorate. Refinish.

Remember Grandpa Martin's old roll-top desk? It's been abandoned in the attic, because the finish is all checked and discolored. My Furniture Refinisher can rescue that desk. I designed this product to work differently than paint removers and strippers. It eliminates the terrible chore of stripping,

sanding and sealing. Because my product doesn't work by stripping. Heaven forbid! Stripping destroys your wood's patina—the rich glow that's created over time.

Pour some Refinisher into a metal tin. Then dip my steel wool Refinishing Pad and rub over a small portion of your piece. That's rub, not scrub. Instantly, you'll see the old, discolored varnish, shellac and lacquer melt away...revealing the original finish as beautiful as it looked years and years ago.

After refinishing, protect your piece. The best way is with a hand-rubbed finish—the traditional way that master craftsmen have always done it. But until recently, nothing existed to let the average person achieve this beautiful finish.

I developed my Tung Oil Finish so anyone can get a hand-rubbed finish. While ordinary varnish sits on top, my Tung Oil gets inside to bring out the inner beauty of your wood.

Protecting your investment.

A lot of people are convinced that caring for fine furniture involves too much time and effort. Absolutely not! To start

with, never wax. You heard me right, never wax. Wax builds up, softening the finish, making things stick...even collecting dust.

My Lemon Oil Furniture Treatment is all you need to keep a warm and healthy glow on your furniture. Unlike wax, my product gets into the wood's grain to highlight its richness. My Furniture Treatment actually helps protect your gold mine from moisture.

And just a few drops is all it takes. No hard rubbing or polishing is required.

Sometimes you come across a piece of furniture with a lot of gunky wax buildup. Use my Furniture Cleaner to remove the old wax, then apply Formby's Lemon Oil Furniture Treatment. And remember that my Furniture Cleaner is perfect for *all* the wood around your house: paneling, kitchen cabinets, etc.—because it cleans without drying.

Give your house a room-to-room search.

Today, people are appreciating the past and its heritage of fine craftsmanship more and more. And more and more people are discovering the treasures they have buried into their basements and squirreled away in their attics. If you haven't looked lately, why don't you investigate that gold mine you may be sitting on? Happy prospecting!

To find out which dealer near you carries my products, call toll-free 800-647-9352. (In Mississippi, 800-222-8216.) And also ask for a free copy of my new Furniture Fact Book.

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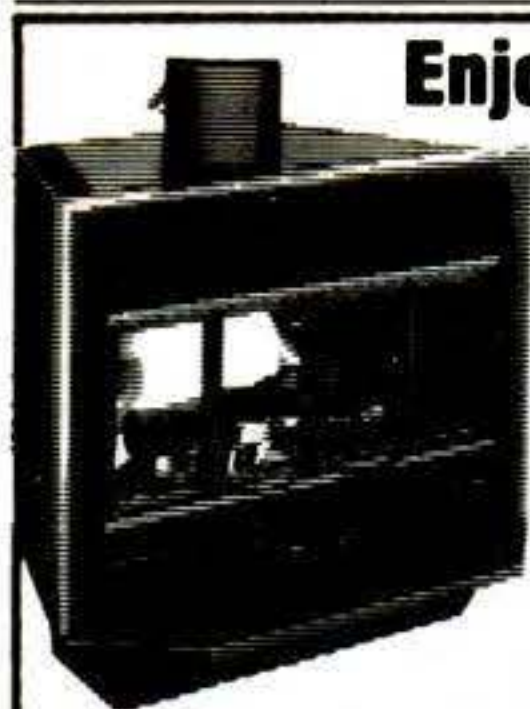
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Home computers

[Continued]



Atari 800 can be used with a conventional TV or with a video monitor. Top opens halfway to expose programming slots that accept cartridges containing BASIC or

When you first switch on the computer, the monitor takes over to give the microprocessor instructions—how to read the keyboard, how to put info on the TV screen, etc. But the monitor also "looks" at what's attached to the computer. It runs a short test and, if you've connected a printer, for instance, it knows that all commands dealing with the printer are operable.

The same holds true when adding a disk system—a high-speed recording device. Data are saved on a record-like disk that's actually a round, flat piece of magnetic recording tape. Normally, disks are very difficult to "bring up" in a computer system. But, because of these advanced monitors, it's simply a matter of plugging in the new disk



special programs such as Personal Finance. Top removes completely to add more memory. First slot (marked 10K ROM) contains the monitor program.

drive when you're ready to use one.

Now let's take a closer look at the three computers.

APF

The APF Imagination Machine is actually made of two separate components. The first is APF's MP-1000 programmable video game (\$130 bought separately), which contains the microprocessor, memory, and video circuits (RF out to color TV). As a stand-alone unit, it can use APF's game cartridges, but will not accept your custom programming. Place it atop the separate keyboard (\$500) and connect them together (see photos), however, and the result is a full-scale computer that accepts your commands.

Continued

Everybody's making money selling microcomputers. Somebody's going to make money servicing them.

**New NRI Home Study Course Shows You How to Make Money Servicing, Repairing,
and Programming Personal and Small Business Computers**

Seems like every time you turn around, somebody comes along with a new computer for home or business use. And they're being gobbled up to handle things like payrolls, billing, inventory, and other jobs for businesses of every size...to perform household functions like budgeting, environmental systems control, indexing recipes, even playing games.

Growing Demand for Computer Technicians... Learn in Your Spare Time

Even before the microprocessor burst upon the scene, the U.S. Department of Labor forecast over a 100% increase in job openings for the decade through 1985. Most of them *new* jobs created by the expanding world of the computer. NRI can train you at home to service both microcomputers and their big brothers. Train you at your convenience, with clearly written "bite-size" lessons that you do evenings or weekends without quitting your present job.

No Experience Needed

You don't need prior training in electronics or computers to take this exciting new course. NRI starts you with the basics, gives you a firm foundation to build on. And your personal counselor is always available, ready to help whenever you have questions.

Assemble Your Own Microcomputer

NRI training also includes plenty of practical experience. You perform

meaningful experiments building and studying circuits on the NRI Discovery Lab.[®] Then you build your own test instruments like a transistorized volt-ohm meter, CMOS digital frequency counter... equipment you learn on, use later in your work.

And you build your own microcomputer, the only one designed for learning. It looks and operates like the finest of its kind, actually does more than many commercial units. But NRI engineers have designed components and planned assembly so it demonstrates important principles, gives you working experience in detecting and correcting problems. It's the kind of "hands-on" training you need to repair and service units now on the market.

Rush Card for Free Catalog... No Salesman Will Call

Send the postage-paid card today for our 100-page, full-color catalog. It describes NRI's new Microcomputer Technology Course in detail, shows all equipment, kits, and lesson plans. And it also tells about other NRI courses...Complete Communications with 2-meter transceiver...TV/Audio/Video Systems Servicing with training on the only designed-for-learning 25" diagonal color TV with state-of-the-art computer programming. With more than a million students since 1914, NRI knows how to give you the most in home training for new opportunity. If card has been removed, write to:



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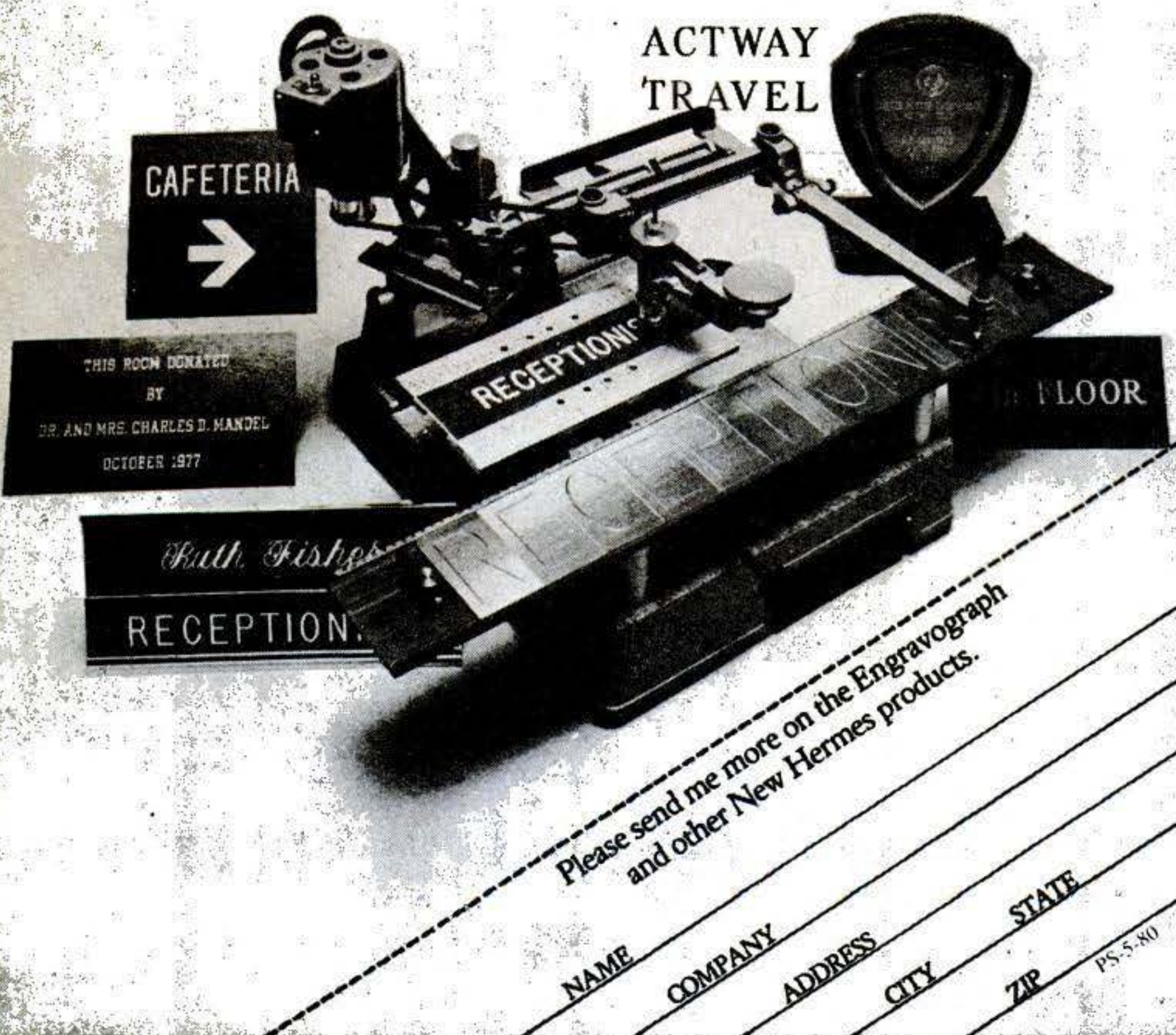
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PS-5-80

Home computers

[Continued]

The keyboard box also contains a built-in stereo cassette deck and speaker. As one track of the cassette is played into the computer to give it machine instructions, the other track can contain conventional audio: human instructions (you record with a separate mike) or programming notes to yourself.

The keyboard is of good quality with conventional key placement—important for text-oriented programs and touch-typists. Also, standard BASIC commands such as PRINT or RUN needn't be typed out each time you need them. Pressing a special control key, along with another key marked with the word you need, automatically spells the word on the screen—a clever, time-saving idea.

The Imagination Machine has the lowest price in this group, and the add-on approach is also economical if you want to start with just the video game. But it does have one drawback. APF has treated each part as *totally* separate: There are two on/off switches, two power supplies to plug in, two reset buttons, and too much confusion until you get used to it.

Atari

Although the Atari 800 will play games with you, it is one of the most serious home computers I've seen. A printer, tape deck, and up to four disk drives simply plug in the side. The top swings up and off (see photos), giving you access to all its memory—including the monitor program saved in a permanent (ROM) memory module. (You may not have any reason to change it now, but it gives you added flexibility if Atari comes up with a better one later.)

Normal programming memory (RAM) can be added, expanding the system up to 48,000 bytes (48K)—more than enough for most home applications.

Keyboard quality is excellent and special keys, such as INSERT and BACK SPACE, make text creation and editing a breeze with the right software.

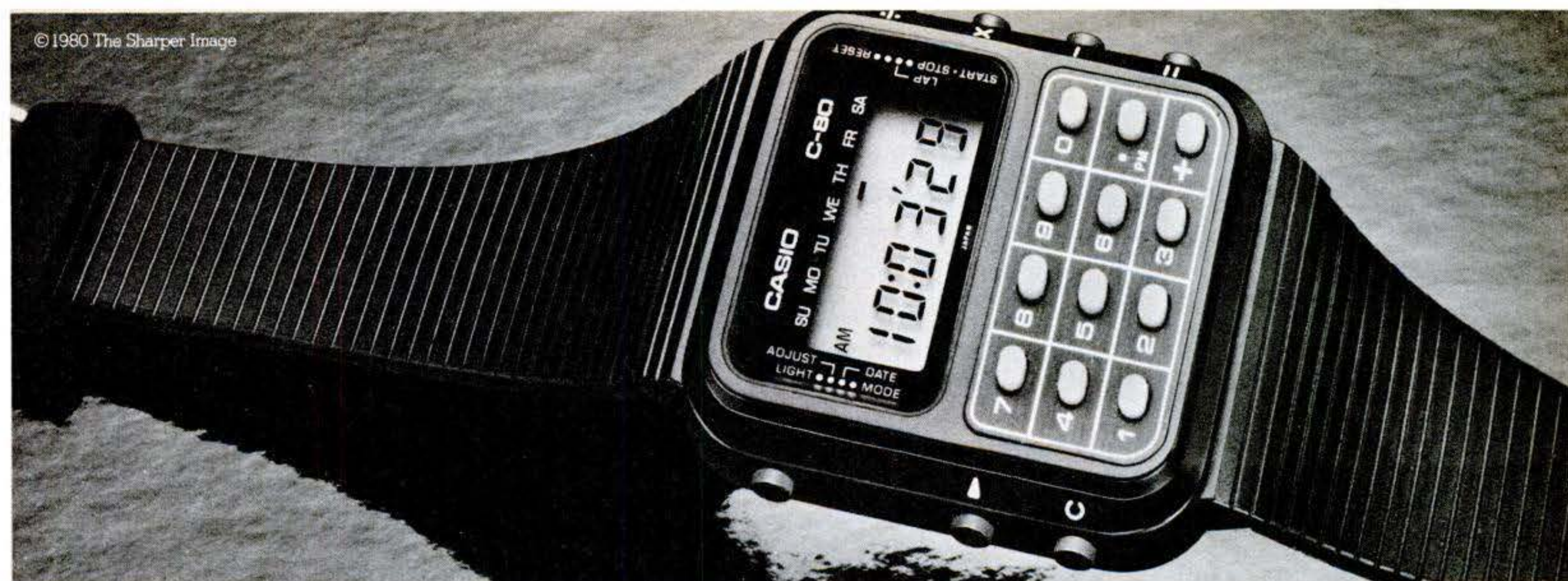
Besides the conventional RF connection for attaching the system to a regular TV set, there is also a video jack for connecting it to a video monitor which, theoretically, should give you an even sharper picture.

It's a good system, but expensive. Besides the cost of the basic system, add in the price of a new color TV.

Texas Instruments

If you like bells and whistles, the TI-99/4 should please you. It accepts

Continued



NOW FOR \$75. THE WATCH THAT REPLACES EVERYTHING.

Introducing Casio's newest, the C-80 Calculator Chronograph. A watch that figures to replace a lot of other watches. And calculators. And stopwatches.

In fact, it even replaces the age-old myth that a timepiece loaded with talent has to be expensive.

The Casio C-80 is priced at only \$75.

A calculator made for real fingers.

Here's the first calculator chronograph that can be operated easily with your fingertips. No need to use a stylus or pen; the keys are far enough apart that even the broadest fingers can work them.

Now you can add, subtract, multiply, divide—perform chain calculations up to six places, plus decimal. Numbers appear in crisp liquid crystal digits. There's even an indicator that tells you exactly which function is being performed.

Stopwatch, 2 time zones—and more.

The push of a button turns your calculator into a fiercely talented stopwatch. You get $\frac{1}{100}$ of a second accuracy, lap times, and up to 59.59 minutes of track-style timekeeping. Timing automatically starts over after the hour.

You also get two time zones; the second zone can be set for 12 or 24-hour time (especially useful for frequent travelers). Hours, minutes and seconds are displayed with reliable ± 15 second-a-month quartz precision. AM/PM indicator is always visible.

Press another button, day of the

week and date appear. And another for built-in night light.

Feather-light, yet rugged.

The 1 oz. case and band are constructed of high impact black plastic. And so lightweight and comfortable, you may not realize that on your wrist you're wearing—among other things—a clever calculator.

Other companies have tried introducing similar watches, only using bulky stainless steel. These steel

mechanical parts to wear out or break. A tough mineral glass crystal prevents scratching. And the tightly fitted case and crystal

provide water resistance for everyday use.

Reserve yours now.

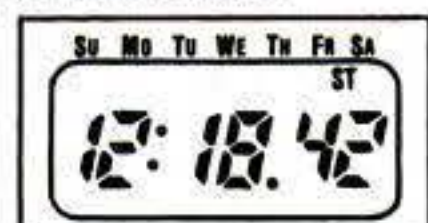
You might wonder why you haven't seen this superb chronograph in the stores. The fact is, it isn't going to be in any stores—not for a while.

However, beginning late March 1980, The Sharper Image will be the first people anywhere to take delivery on these exciting Casios. And you can reserve yours now. But please order immediately to be assured of earliest delivery. As quantity is limited, orders will be handled on a first come, first served basis.

And as always, The Sharper Image guarantees your satisfaction. If not delighted with your new Casio, simply return it within two weeks for a full and courteous refund. One-year manufacturer's warranty and 15-month (normal use) battery included.



Normal Time Display; hrs./mins./secs. AM/PM, day and 2 time zones.



Stopwatch Display; 1/100 sec. timing. Auto start-over at 1 hr. Lap times.



Calculator Display; add, subtract, multiply, divide—to 6 places with decimal.



Calendar Display; day/date. Auto end of month adjustment.



versions sacrifice the comfort, lightness, and handsome appearance provided by the latest advanced plastics.

What's more, this Casio chronograph is built incredibly rugged to provide years of reliable service. There are no

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Volkswagen's new Pickup: It's built like

Where is it written that a truck has to drive like a truck? Certainly not on that brand new Volkswagen Pickup Truck.

When it comes to going, a VW Pickup can pick 'em up and lay 'em down with the best of 'em. Under its aerodynamic hood is a very dynamic engine. A fuel-injected, over-

head cam powerhouse that can outaccelerate even an MGB.

And should you ever catch up to a VW Pickup, you'll never catch it wallowing through corners like other trucks. Its front-wheel drive and front-mounted transverse engine help keep it



a truck, but drives like something else.

moving nimbly. Even when the road throws it a curve. The steering is precise and quick because it's Volkswagen's rack-and-pinion system.

What's equally impressive is how good a pickup a VW Pickup is. It's the only truck in its class with a fully unitized body and double-wall

bed construction for extra strength. And its heavy-duty suspension takes the tension out of hauling over 1100 pounds of stuff. So a truck is a truck is a truck, eh? Well, not if it's a Volkswagen

Pickup Truck. Then it's something else.

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AGAIN**



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Some men taste it all: Rich warm flavor. Smooth even taste. Solid satisfaction.

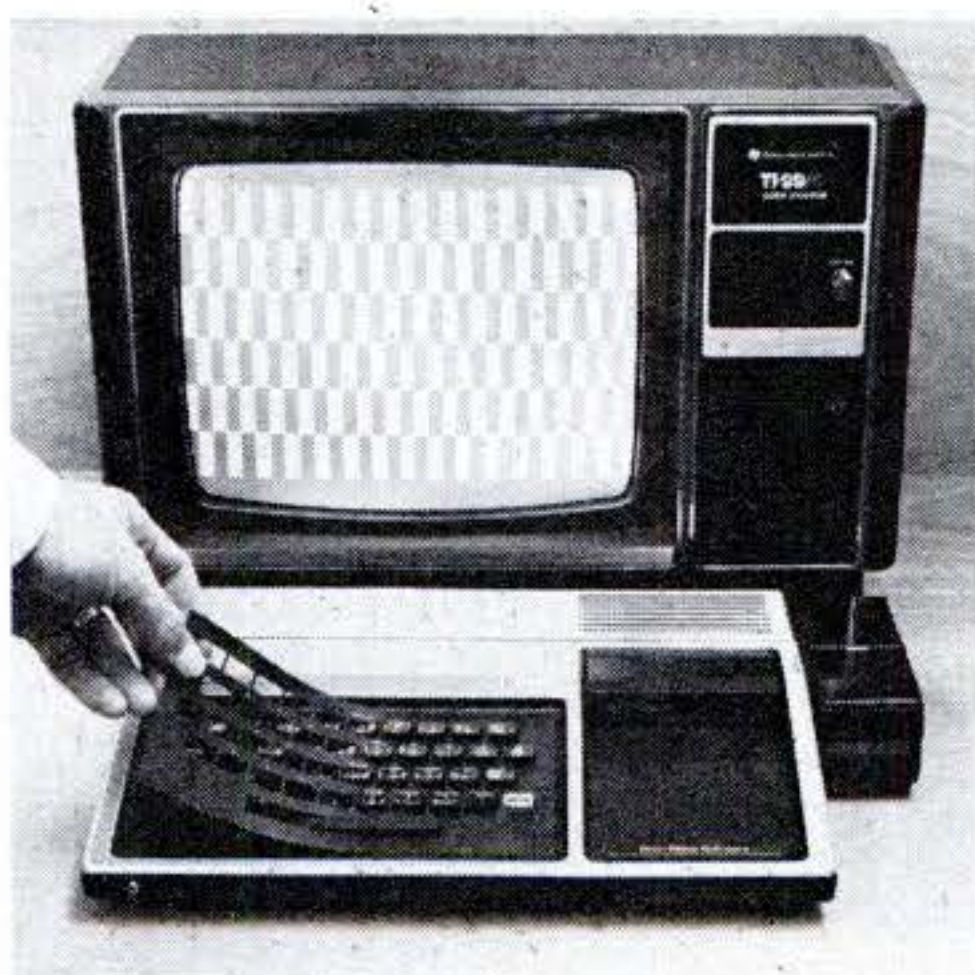
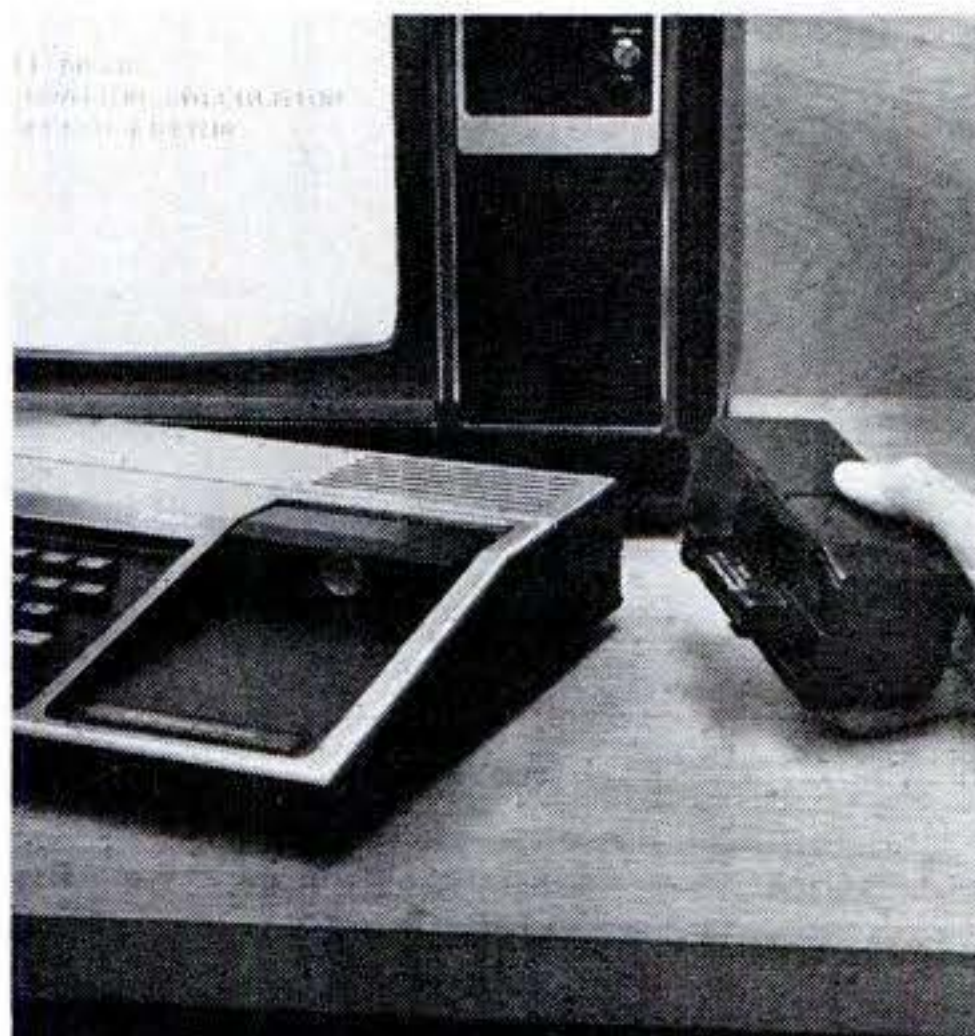
Only from the Camel Filters blend of Turkish and domestic tobaccos.

Warning: The Surgeon General Has Determined That Cigarette Smoking Is Dangerous to Your Health.



Home computers

[Continued]



Color monitor is included in TI's system. Add-ons, such as speech module (top right), plug into side of unit. Each module has an additional socket to accept another module, allowing piggyback connections for printer and disk. Programming car-

all the conventional add-ons, such as disk drives, a printer, and a cassette tape recorder, through a side connection. But there is one add-on unique to TI: a speaking module. With it, the computer talks through the speaker in the video monitor (\$150 for the module plus \$45 for the software necessary to use it).

The module comes with about 300 words (expandable to about 900), and any one or strings of them can be called in your program at any time. The module I tried was just a prototype, but the intelligibility of the voice

tridges plug in front and contain BASIC, plus other specialized programs. Some programs redesignate keyboard keys (drawing electronic pictures, for example). For this, an overlay is used (lower right) to show each key's new function.

was incredible. You haven't lived until your home computer says "hello" and asks you to "please enter a number." Add together the speech, graphics, and musical capability of this machine, and it could almost become another family member.

Cost of the system (\$1150) isn't bad, considering that it includes the color-TV monitor. There was one disappointment, however. I found the keyboard more difficult to use than the others. It is not standard, so a touch-typist may have a few problems with it. **P 5**

Home computer specifications

Brand	Model	Price(\$)	RAM/ROM (K)	RAM/max (K)	Graphic resolution	Microprocessor	Video source	Remarks
APF, 444 Madison Ave., New York NY 10022	Imagination	600	9/14	17	256x192	6800	RF	Built-in cassette
Atari, 1265 Borregas Ave., Sunnyvale CA 94036	800	1000	8/10	48	320x192	6502	RF/Video	Accepts up to 4 disk drives
Texas Instruments, Box 53, Lubbock TX 75222	TI-99/4	1150	16/26	16	256x192	9900	Video (inc.)	Speech option avail.

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Let Cruise Sentry cruise control, monitor your speed, keep "The Bear" from your door and conserve your gas.

Cruise Sentry I or Cruise Sentry II—installs readily in any gasoline powered car, van or truck. Fits domestics and imports, stick or automatic, front or rear drive, electronic or standard ignition.

Cruise Sentry comes with a free full-year warranty—or a special 2-year warranty if you prefer.

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These floor or bench model 14" drill presses are really **HEAVY DUTY** and we only have a few left at this low liquidation price. Orders will be filled on a first-received, first-served basis.

They drill fast and smooth into plastic, wood, brass, aluminum, cast iron and steel. Base and head are made of fine-grained cast iron and the column is heavy for rigidity and smooth drilling.

The table swings 360° and tilts 45°. Rack and pinion table adjustments assure fast and precise placement. A recessed light in drill head gives bright illumination to your work area.

- 11 $\frac{1}{4}$ " diam. table with "T" grooves
- 6 $\frac{1}{2}$ " from spindle center to stand base
- Spindle to base (max.) 23 $\frac{1}{2}$ "
- Spindle to table (max.) 15 $\frac{1}{4}$ "
- Height (table model) 40 $\frac{1}{2}$ "; weight 160 lbs.
- Chuck is $\frac{5}{8}$ " No. 3 J.T. Arbor
- Quick release belt tension
- All belt pulleys on ball bearings
- Capacitor start 110V motor; grounded receptical 10 Amps.

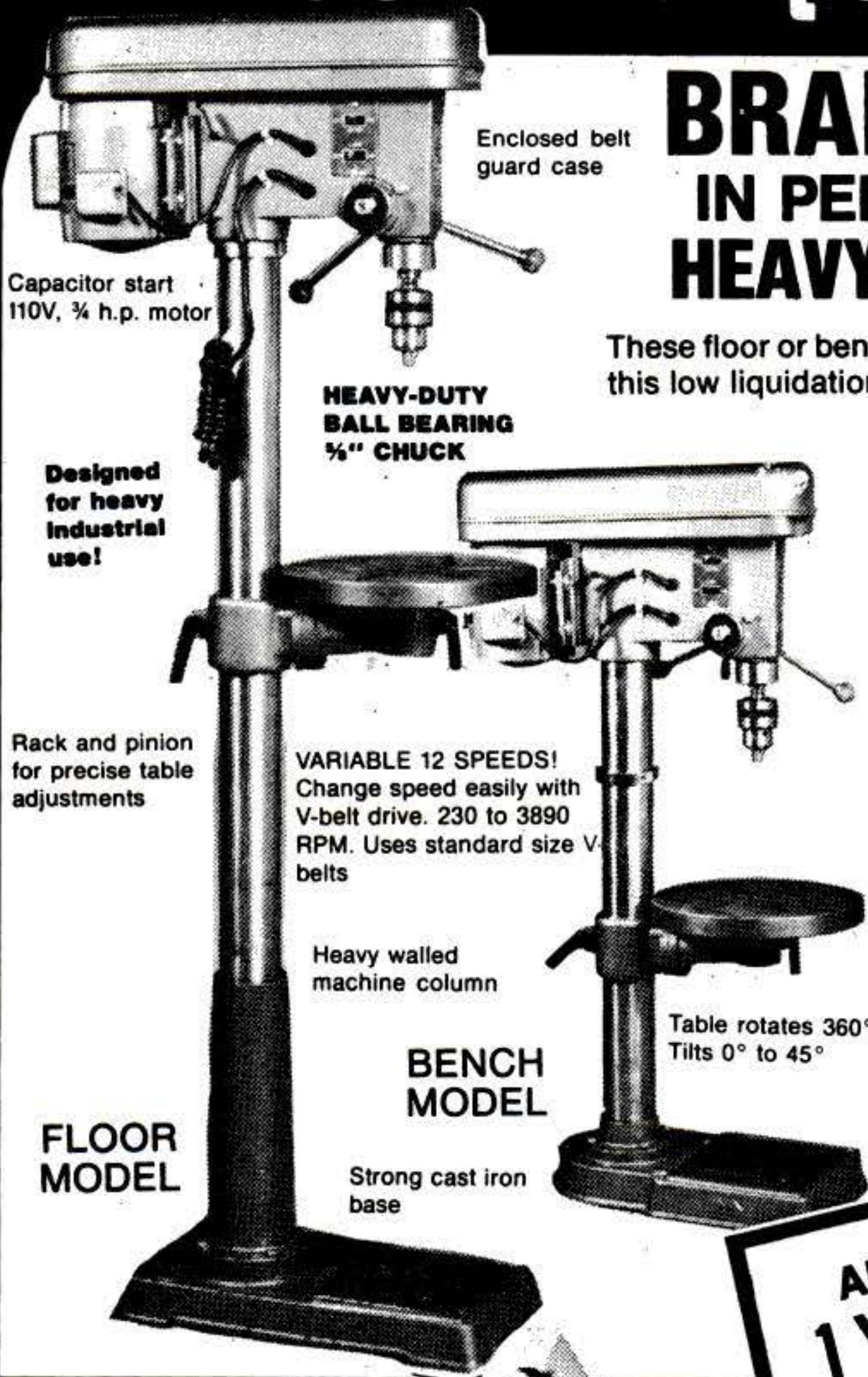
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Capacitor start
110V, $\frac{3}{4}$ h.p. motor

Designed
for heavy
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Rack and pinion
for precise table
adjustments

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Change speed easily with
V-belt drive. 230 to 3890
RPM. Uses standard size V
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Heavy walled
machine column

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MODEL**

Strong cast iron
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**FLOOR
MODEL**

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- Has AC switch • Easy chopper action in pipe, tubing, conduit, angle iron, PVC, channels (wood with wood blade), etc.
- Powerful 2 H.P. motor • Folds down into portable unit • Vise swivels up to 45° • Chain lock & insulated handle for safety • Cuts 4" high • Comes with vise, one abrasive and one metal wheel • Easily cuts through brick, stone and tile (most metal & masonry).

Reg. Retail \$259.00

LIQUIDATION PRICE

\$159⁰⁰

PLUS
SHIPPING
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APPROX.
40 LBS.



COMPACT HOME/SHOP DRILL PRESS

Here is an opportunity to save a big \$130.00 on a perfect drill press for your home or workshop. This compact model features 5 speeds ranging from 860 through 3400 R.P.M.

- 5 speeds 860-1200-1700-2500-3400
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- 8" x 8" table easy to adjust
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- Compact size for any bench 28" height
- Powerful $\frac{1}{2}$ H.P. ball bearing motor

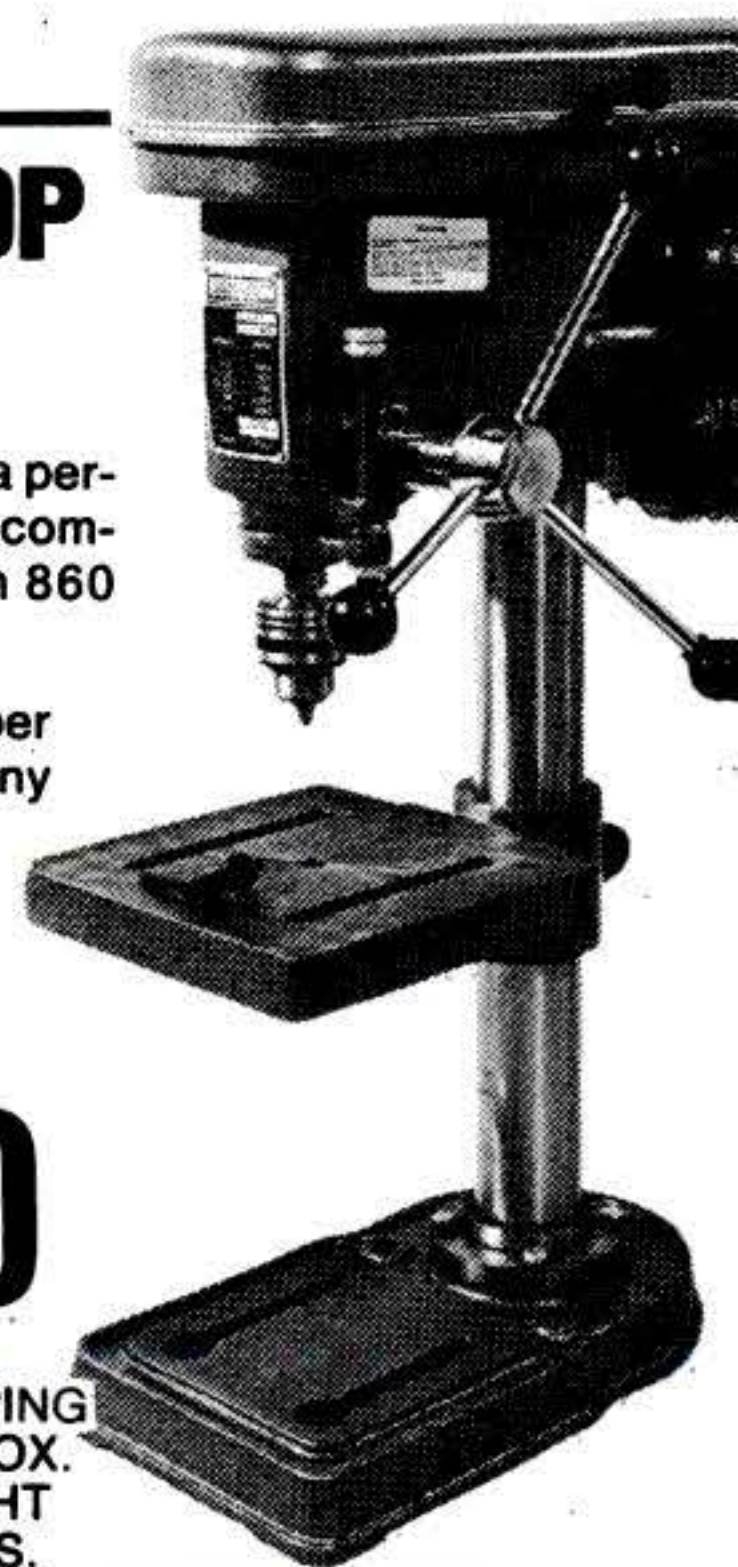
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PRICE ...**

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LIMITED SUPPLY

TABLE SAW, BAND SAW & CUT-OFF SAW



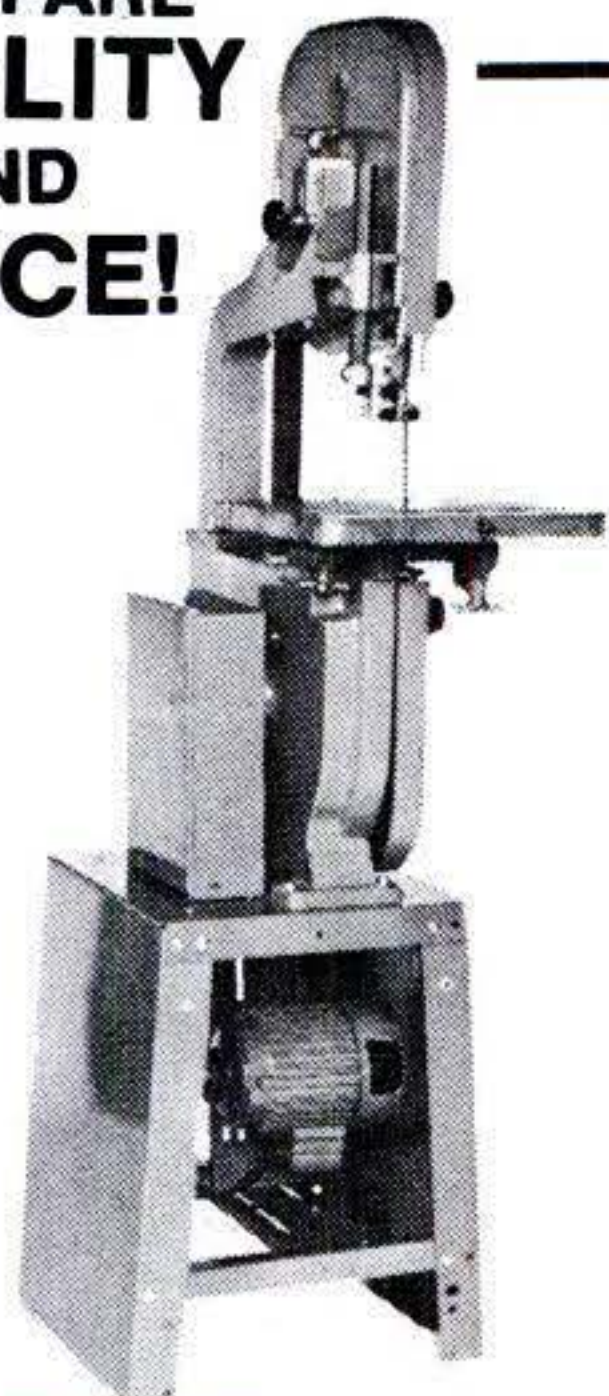
HEAVY DUTY 1½ H.P. TABLE SAW 10" CONTRACTORS SPECIAL

• Includes extension wings as standard equipment • "See-thru" blade guard with splitter and anti-kickback attachment • Unique 24" rip capacity right or left of blade • Lubricated-for-life ball bearing construction • Up-front controls • Fast-Lock self-aligning rip fence • Extra-large 40" x 27" table overall.

SPECIFICATIONS:

Table: Working height on stand, 37½". **Blade:** Diameter 10"; arbor ½". **Capacities:** Depth of cut 3½"; 2½" at 45°; rip 24" (R & L Blade). **Speed:** Using standard pulleys and 3450 RPM motor, 4000 RPM. Capacitor start with manual reset button.

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AND
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14-INCH WOOD CUTTING BAND SAW

WITH ¾ H.P. HEAVY DUTY MOTOR

• Includes stand and belt guard plus capacitor start motor with push button switch • Upper blade guide construction • Smooth running balanced wheels • Rugged 14" x 14" table • Lubricated-for-life ball bearings • Exact tension blade scale • "Quick" table insert.

SPECIFICATIONS:

Dimensions: Approx. width 22"; Height 66". **Table:** Size 14" x 14"; Groove ¾" Deep by ¼" Wide; Tilt to 45°; Height from Floor 43". **Blade:** Length—Max. 93½"; Min. 91½". **Capacities:** Frame to Blade 13¾"; Under Guide and Wheel 6¼". **Speeds:** (With 1725 RPM Motor) 3000 RPM.

STANDARD EQUIPMENT:

Band Saw with Steel Stand, Belt Guard, Motor and Switch. Includes Basic Machine with Stand; Wheel, Blade and Belt Guards; 6" Arbor Pulley; Motor Pulley (with ½" Bore); Blade Guides; Wood Cutting Blade; 2 Blades included, 6 Tooth and 10 Tooth.

Reg. Retail up to

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APPROX. WEIGHT 200 LBS.
(Does not include blade.)



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Power washer really cleans up



I live in an area with very high water
pressure—105 psi—so when I wash a
car, lawn furniture, and other items, I
can direct a strong stream of water at
them. But the pressure isn't high
enough for stubborn items that re-
quire powerful blasts of water for
thorough cleaning.

That's why I decided to try Sears'
new Hydro Wonder Washer—a recent-
ly introduced power washing wand.
To make it work, you have to hook up
a garden hose and the output hose
from a one-hp compressor. When you
turn it on, though, the result is a rev-
elation. The Sears washer can produce
a pressure of up to 175 psi.

I used the wand to clean my car and
house siding, and even to degrease a
car engine. The results were quite sat-
isfactory. I especially liked the con-
trols, which allow you first to rinse the
item you want to wash with plain
water, then switch over to applying
detergents, and finish up with a blast
of air for drying.

The one drawback may be that you
have to get as close as two to five
inches from the surface to be cleaned.
That lets a lot of spray splash back at
you. If you angle the wand, this can be
reduced to some extent. But be pre-
pared to get wet, and wear some
waterproof boots, too.

The Hydro Wonder Washer (catalog
#30 HT 16202) costs \$77.99. It comes
with three four-ounce bottles of deter-
gent and degreaser. Sears also sells
larger containers of these cleaners, or
you can use other types available in
supermarkets or hardware stores.

—Herbert Shuldiner

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The P34A is our top of the line portable. It heats, it refrigerates and with specially designed electronic circuit control (patent applied for) it allows you to dial a complete range of temperatures from very cold to very warm. You wine buffs will find it indispensable to chill up to 1 doz. wine bottles at just the right temperature. Low battery indicator warns you when you need a recharge and the sensing circuits efficiently control your power consumption to save on battery drain. This is our best-of-the-line, recreational fridge and food warmer with all the bells and whistles for the discerning buyer who demands quality, size and complete versatility. Use from a cigarette lighter receptacle or plugged into house current with our optional 110 volt adaptor.

ORDER TODAY WITHOUT OBLIGATION!

Simply complete the attached order form or phone collect and we'll rush you your portable on our no risk 21 day trial offer. Each unit comes with complete instructions and a written 1 year warranty. In the unlikely event you ever need service, we have major service centres in New York, Arizona and Canada. When you receive your Koolatron, use it constantly for 3 full weeks without risk.

If you ordered our optional 110 volt adaptor, plug it in, then use your portable immediately as a bar fridge or around the patio or pool. Next plug the fridge into your car or RV. Take your family out for a weekend trip. Enjoy fresh home-cooked food as you thumb your nose at those expensive restaurant stops. If after you've thoroughly tested it, you don't agree that your Koolatron represents a major breakthrough that will save you time, money and bother for years to come, send it back for a full refund. You can't lose... we guarantee it.

So be among the thousands to discover that the ice age is over. Don't waste another dollar on ice... order your Koolatron with no obligation today!

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Send me with full refund privileges.

— Koolatron P10 at \$129.00 (\$139.00 in Canada)

— Koolatron P34 at \$169.00 (\$179.00 in Canada)

— Koolatron P34A at \$189.00 (\$199.00 in Canada)

— Koolatron 110V adaptor at \$29.95 (\$34.95 in Canada)

Please add \$8.00 for handling and delivery per unit.

No charge for shipping adaptor if ordered with unit.

Add \$3.00 for shipping adaptor by itself.

(N.Y., Ont. and Quebec residents add sales tax).

I understand that I may return any item undamaged within 21 days and receive a full refund if I am not satisfied.

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— IPS2 —

Travellin' Fridges

FROM ONLY \$129.

Space age breakthrough creates a new line of Koolatron electronic portable refrigerators and food warmers.

You're nicely away on your long-awaited vacation, camping trip or long weekend with the family. You're comfortably cruising in your car, van or rec. vehicle along a busy interstate with few rest stops or restaurants. You guessed it... the kids want to stop for a snack. But your Koolatron P34 or P34A is full of sandwiches, cold pop, fried chicken... home made, fresh and cold. The family helps themselves and you've saved valuable vacation time and another expensive restaurant bill.

You're a commuter, a salesman or a trucker and you spend many hours in your vehicle daily. Now with your amazing Koolatron P10 plugged in beside you, you open the lid and instantly fresh food and drinks are at your fingertips. Just for the price of a good cooler and one or two seasons of buying ice, (or about 10 family restaurant meals), all the marvels of home refrigeration are available electronically. An amazing space-age miracle... the thermo-electric solid state module... makes these portable refrigerators possible.

These amazing heat pumps have not only gone to the moon, but have provided the breakthrough for Koolatron's portable fridge revolution.

THOUSANDS IN USE

Koolatron now has tens of thousands of electronic fridges in use worldwide using these same powerful solid state modules. Built to take it, two of these electronic modules are encased in tough, plastic insulated chests that are designed to be rugged and trouble-free. Non-rusting hinges and latches prevent corrosion in salt water environments. And with only one moving part (a small 12 volt fan) Koolatron's portables seldom see a service depot. Now you can enjoy Koolatron's whole family of electronic portable refrigerators and food warmers that eliminate costly ice and provide "home refrigeration" convenience at sane and sensible prices.

**MODEL P10 -
CAR FRIDGE
& FOOD WARMER**

\$129.00
(in Canada \$139.00)



Holds approx. 17, 12 oz. pop cans - refrigerates in air temps. up to 95°F. Also keeps hot foods hot (150°F) at the flick of a switch. Deep rich blue Polypro plastic case. Ext. 16" L x 11" H x 11 1/2" W. Int. 11" L x 8" H x 8" W. with 10 litre capacity (11 qts.) weighs 10lbs. empty. Operates from supplied 12 volt power cord in vehicles or with optional 12VDC/110VAC power adaptor.

As a travel fridge the P10 keeps foods and beverages fresh and cold wherever you go. Carry insulin, medical samples, dietetic foods. Great for private planes and golf carts. Photographers use it for films. Mothers... now you can refrigerate baby's formula in your car then heat it with the flick of a switch or keep it cold. Powerboaters, just plug it into your boat's cigarette lighter to keep a day's food and drink ice cold without going ashore for ice. With your engine off, you can operate for up to 6 hours and still start your engine. "A low battery" indicator warns you when it's time to recharge. With the power off, your P10 keeps everything hot or cold for many hours in its well insulated case.

With our optional 110 volt adaptor you'll also find endless uses wherever house current is available... at your cottage... as a bar fridge... in your motel room for a midnight snack and drink... as a small office fridge... or beside your pool. Use as an auxiliary home fridge when you're having a party.

**MODEL P34 -
RECREATIONAL
FRIDGE**

\$169.00
(in Canada \$179.00)



Holds over 40 lbs. of food and beverages or 48 pop cans. Refrigerates in air temperatures up to 95°F. Rugged ABS case in sand beige color with dark brown non-corroding latches and handle. Large 34 litre capacity (1.2 cu. ft.) weighs 17 lbs. empty. Ext. 21" L x 16" H x 16" W. Int. 16" L x 12" H x 11 1/2" W. Operates on 12 volts DC with supplied power cord or with optional 12VDC/110VAC power adaptor.

The P34 is the full-size member of the Koolatron family of portable electronic fridges. It is designed especially for the serious traveler and outdoorsman and will refrigerate more than 3 times the contents of the P10. As a hunter, camper, boater, you'll be amazed at the capacity and convenience. Fits into any boat, van or camper or back seat of your car. Plugs into your cigarette lighter receptacle and refrigerates over 40 lbs. of food (no space wasted by ice), yet it draws no more power than the P10. With our optional 110 volt adaptor, you'll find endless uses as a bar fridge, cottage fridge, office fridge. Your P34 has all the advantages of the P10 without the heating cycle or low battery indicator but with all the capacity needed by the outdoorsman.

LOOK AND LISTEN

By WILLIAM J. HAWKINS



Sharp Multivision TV



Quasar talking oven



Sinclair flat CRT TV

Speak to me

"It's four thirty," said the small clock radio in a somewhat gravelly voice.

"Your dinner is ready," added the microwave oven in a distinctly feminine tone.

"Come on," I said out loud, doubting what I had just heard.

"On?" queried another voice, this time from a nearby TV set. "Okay," it replied, and the set popped to life, automatically fine-tuning a midday soap.

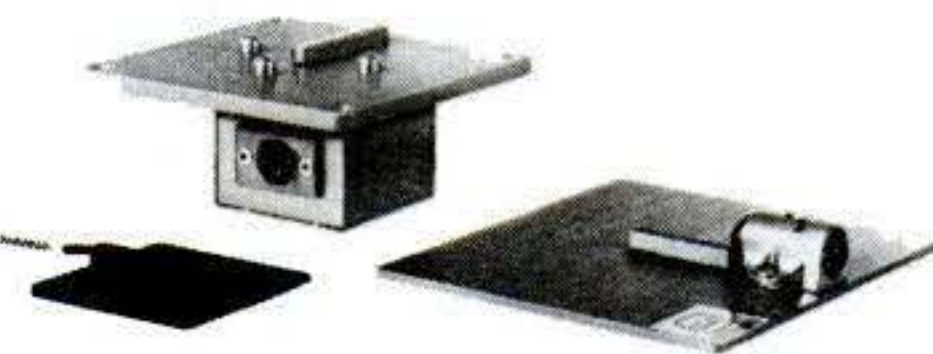
I was surrounded by home appliances of the future at the last Consumer Electronics Show. To my left, a man was listening to a desk-top calculator; to my



Sharp talking clock



Sharp talking calculator



Crown microphone

right, a woman was giving instructions to a home computer through its attached microphone.

It was eerie. Using new voice-recognition techniques, some of these appliances understood the spoken word. And, using digital synthesizers—circuits that can utter specific sounds based on how they're programmed—they spoke in clear, concise English.

They were prototypes, but you can't help wondering how long it will be before your stove apologizes for burning the farina or your vacuum pleads with you to empty its bag. Texas Instruments now sells a talking computer (see the article in this issue), and General Instruments has

just announced a new synthesizer chip that can be programmed to speak in a mechanized-type voice—or precisely mimic any human voice. So, when your new John Wayne refrigerator tells you to "beat it till supper time," you can bet you'll stay on your diet.

Other prototypes were more visual: Sinclair has put its flat CRT to work in a three-inch diagonal desk-top TV. Its price, when available, will be about \$125. Sharp's multivision color TV can electronically break the screen up into nine separate areas. Each area will display a still picture frame, so you can see what's on most of the channels all at once or show consecutive frames of one event.

And, finally, one product that's available now is a new recording microphone from Crown. It's called a pressure-zone mike and it disregards conventional audio phase cancelling. The result: Bolt it to the floor of a recording hall and it will record only the instruments, say its maker. Paper rustling and coughing are ignored. It's priced under \$350.

Quick looks

- By the time you read this, program captioning for the deaf should be in full swing on ABC, NBC, and PBS television. To see the caption lines, an adapter box, available from Sears, must be connected between the antenna and the set. The box extracts the text information from unused scan lines in the TV broadcast and superimposes the lines at the bottom of the normal picture.

- Sales of VCR's are up over 70 percent at the beginning of 1980 compared to '79 and strong competition between the major networks is bringing out the best in movies for us to tape. Perhaps that competition may extend into the morning hours, too. It doesn't take a network president to figure that good late-night movies will be taped—along with their commercials—and that prime-time television may eventually become a thing of the past.

- The latest on video discs? Matsushita is dumping its groove-guided pressure pickup system and is joining with JVC to produce its Electro-Tracking Capacitance pickup system. This capacitance technique is designed to be inexpensive, like the RCA Groove-Guided Capacitance system, but grooveless, like the Philips-MCA Optical-Tracking pickup system, so special effects such as slow scan and freeze-frame can be built in. Meanwhile, RCA has signed a deal with CBS for the manufacturing and distribution of SelectaVision discs. That should guarantee software availability when the machine is introduced in December.

A P S P.S.

Ordinarily, I wouldn't tell you about something that's being discontinued, but this one is different: J.C. Penney has filled a unique hole in the home audio/video system with a VTR Component TV. It looks like a hi-fi amp, and delivers high-fidelity TV audio to your system, but it also has a built-in, five-inch picture tube with tuners to monitor recordings off your VCR. You can still get one (about \$200).

Warning: The Surgeon General Has Determined
That Cigarette Smoking Is Dangerous to Your Health.

The Vantage Point

Where great taste and low tar meet



REGULAR: 9 mg. "tar", 0.8 mg. nicotine av. per cigarette by FTC method;
MENTHOL: 11 mg. "tar", 0.8 mg. nicotine, av. per cigarette by FTC method;
100's: 12 mg. "tar", 0.9 mg. nicotine, av. per cigarette, FTC Report DEC. '79.

THERE'S MORE TO CUTLASS SEDAN THAN MEETS THE EYE.



Cutlass Watchers, compare Cutlass for mileage. Don't be attracted to this car just because of its looks. About a half-million people are going to buy a Cutlass

V6 ENGINE

20
EPA Est. MPG

27
Hwy. Est. MPG

DIESEL ENGINE

22
EPA Est. MPG

34
Hwy. Est. MPG

this year and many will do so because of the V6 engine. This spunky, economical powerplant has an EPA estimated mpg of **20** and an estimated 27 out on the highway. With the available diesel V8, you get even better mileage.

REMEMBER: Compare the boxed "estimated mpg" to the "estimated mpg" of other cars. You may get different mileage, depending on how fast you drive, weather conditions, and trip length.

Actual highway mileage will probably be less than the estimated highway fuel economy. Estimates lower in California. Diesel not available in California.

Oldsmobiles are equipped with GM-built engines produced by various divisions. See your dealer for details.

Compare Cutlass for comfort and flair. This mid-size four-door is an Oldsmobile. And that means the comforts of home are yours once you slip inside. The luxurious seats you see below come as standard fare on Cutlass Brougham Sedan. The front seats adjust independent of one another. Rich velour is standard. Automatic transmission, power steering and power brakes are standard. And you can select from 85 other available luxury and convenience items that will make your Cutlass *your very own Cutlass*.



Compare Cutlass for its high resale value. It's a fact: Cutlass has one of the highest resale values among all mid-size cars. That's important when you're buying a car. Cutlass's high resale, in effect, can provide added value at trade-in time.

These days you owe it to yourself to compare before buying. Stop in at your Oldsmobile dealer today. He'll do everything he can to make you one of the half-million Cutlass Watchers who'll become Cutlass Owners this year.

It'll be mighty nice knowing that the Cutlass you bought was the right car to buy.

No wonder Cutlass is now America's #1 selling car.



Oldsmobile

WE'VE HAD ONE BUILT FOR YOU

PS ratings— test report in a nutshell

The ratings are based on test results and measurements. Results should be read with the understanding that they reflect tests only on our sample cars. An excellent rating is 5 points; very good, 4; good, 3; fair, 2; poor, 1; very poor, 0.

	AMC Concord	Chevrolet Malibu	Chrysler LeBaron	Ford Fairmont
EPA economy	3	3	2	3
Acceleration	4	1	1	2
Braking	3	3	3	2
Handling	2	3	2	2
Maneuverability	5	5	4	5
Ride comfort*	2	4	4	3
Quietness	1	3	1	0
Roominess	4	4	4	4
Visibility	5	5	5	5
Entry/exit ease	3	4	5	3

*Authors' evaluation; not measured

Midsize Wagons

— roomy, comfortable,
all-purpose vehicles

By **JIM DUNNE** and **ED JACOBS**
PHOTOGRAPHS BY GREG SHARKO

Station wagons haven't been overlooked in today's urgent drive for fuel economy. Smaller wagons are now being called on to do the work of larger,

heavier predecessors. Because of good design, however, losses to the wagon buyer are minimal.

For many people, versatile midsize six-cylinder wagons like AMC Concord, Chevrolet Malibu Classic, *Continued*



Versatility, reasonable size, and respectable fuel economy are strong points of these midsize wagons (clockwise from foreground): Chevrolet Malibu, AMC Concord, Chrysler LeBaron, and Ford Fairmont.

Chrysler LeBaron Town and Country, and Ford Fairmont Country Squire are excellent substitutes for full-size cars—even full-size wagons, in some cases. Sure, interior volumes and trailer-towing capacities are reduced; but carrying capacity, ride comfort, high-level luxury, and other big-wagon features can still be found in reasonably good measure. And you get them in more economical, easier-to-drive cars.

Their smaller size makes them simpler to handle in traffic, and they can be easily parked in spaces that full-size cars and wagons would have to pass up. In addition, their lighter weight cuts steering effort and helps make them easier to maneuver in tight quarters.

Malibu and LeBaron are rated as six-passenger models, though the seating is more crowded than in full-size wagons. Fairmont and Concord are designed to seat five, but six

adults could probably be squeezed into them, too. If luxury and comfort are important, you can get pretty much whatever you want on these cars.

Cargo-carrying capacity is obviously one of the most important considerations with this sort of utility vehicle. Cargo capacities range from about 60 cu. ft. to nearly 80, more than enough to serve many families and businesses. And these cars can do it with much better economy than full-size wagons with *their* smallest engines.

While the biggest advantage of these cars—better fuel economy—stems from their smaller, six-cylinder engines, the biggest drawback also stems from the power plants. Sluggish performance dogged three of the cars. Their engines are adequate for everyday driving, but acceleration is lackluster, and they don't have very much power in reserve for passing or hill climbing. Engine smoothness, though, was a pleasant surprise. While we did notice some vibration at times, as when starting a cold engine or climbing a hill, we don't think the average driver would object.

Except for the Malibu, interior noise levels were definitely higher than those of similar sedans. Part of the increased noise stems from the open rear compartments found in all station wagons, which allow drivetrain and road noise to enter the passenger compartment unabated.

AMC Concord

Concord is the oldest design in our group, and has the biggest engine. Surprisingly it was best in both our

acceleration *and* economy tests. It is smallest inside and out, and is the second lightest, just nosed out by Fairmont. Although its body styling is dated, AMC's designers are continually refining things to freshen its looks.

Concord is considerably smaller inside than the others, although not really cramped. Design tricks such as setting the dash well forward of the passenger give a feeling of more spaciousness.

The driving position is good and so is visibility all around. The front seats are comfortable and look good, with headrests that retract flush with the top of the seat.

Instruments are neatly clustered in front of the driver. Unfortunately, the important high-beam indicator is blocked by the steering wheel. Radio and heater/air-conditioner controls are grouped to the right of the steering wheel and are easy to reach.

Rear seating is a bit tight, since Concord has about two inches less hip room than its competitors. The seat backs are extremely upright and are considerably less comfortable than in front. They are also relatively hard, and the padding isn't very well contoured.

In terms of luxuriousness, Concord gives away nothing to the others. Carpeting expanses on the door panels and seat backs are among extra touches in a decor package that seems better thought out than those on some newer cars.

Concord's best features center on its 258-cu.-in. engine. In the second-lightest car, it was nearly three seconds quicker to 60 mph than Fairmont, yet still got better fuel economy in our 55-mph cruise test. Concord also tied Fairmont for second place in the high-speed handling test, and tied the Malibu for top honors in maneuverability.

Chevrolet Malibu

Aside from its unnecessarily complicated split-tailgate arrangement, the Malibu wagon offers a fine combination of comfort and convenience. Its low interior noise levels rival those of many sedans, perhaps because Malibu alone offers separate body and frame construction.

Besides providing the most front leg-room, Malibu offers a comfortable driving position—somewhat more flattened out than some cars because

Continued

EPA fuel mileage (mpg)

	AMC Concord	Chevrolet Malibu Classic	Chrysler LeBaron Town and Country	Ford Fairmont Country Squire
Highway	25	26	23	27
City	18	19	16	20
Calif. city	16	*	*	*

*Six-cylinder engine not available in California

Observed fuel mileage (steady-state mpg)

	AMC Concord	Chevrolet Malibu Classic	Chrysler LeBaron Town and Country	Ford Fairmont Country Squire
35 miles per hour	26.7	26.3	23.1	25.8
55 miles per hour	21.1	19.0	17.6	19.5



Concord locks brakes in 60-mph panic stop, yet slides fairly straight. With cold brakes, Concord's stopping distance was longest; with hot brakes, next longest.

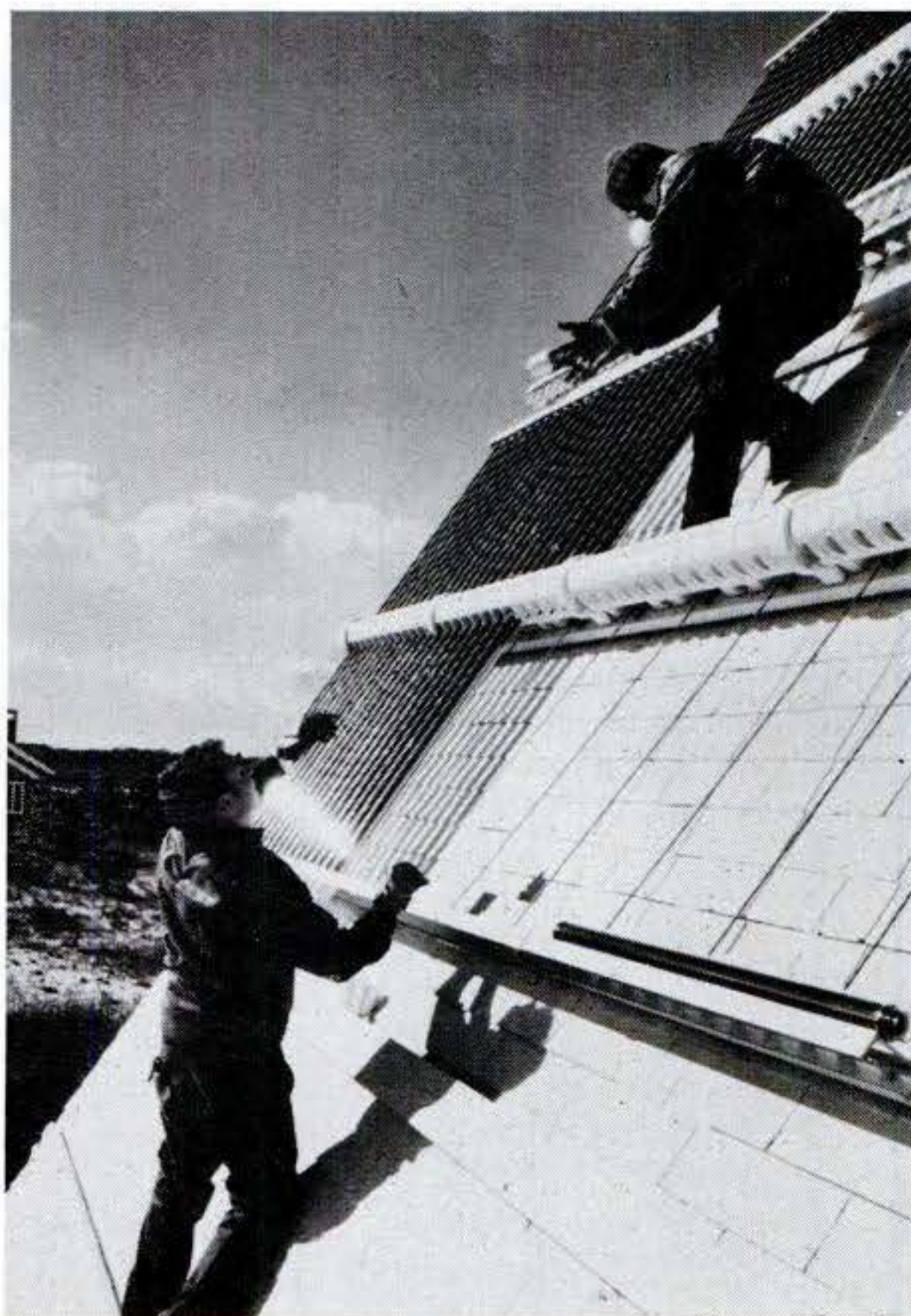
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the seat is closer to the floor, but not objectionable. Like the other cars, visibility all around is excellent, and seating comfort is good.

Our Malibu had the optional gauge package, and provided much important information. Only the clock was hard to read. Like the Concord, the high-beam warning light was blocked by the steering-wheel rim.

Our Malibu had low interior noise and was remarkably free of rattles and squeaks, despite the increased vibration from the harder-riding P-metric tires now being used throughout the industry to boost fuel mileage. There was also some noticeable engine vibration when climbing a hill or passing another car, but it wasn't objectionable.

Engine performance was below what we expected. It surged noticeably at turnpike speeds, but that wasn't our major objection—lack of power was. Careful gear selection gives the feel of good acceleration away from a stop, but beyond mid-range speeds Malibu goes flat, with comparatively little in reserve, as with the LeBaron and Fairmont.

As in Malibu sedans, the rear windows do not roll down, a deficiency many owners find objectionable. Chevrolet claims that the rear vent windows and the car's ventilation system furnish all the fresh air rear-seat passengers will want. We don't agree. Another objection is Malibu's split-tailgate design, which looks flimsy and is more complicated to operate than the one-piece designs found on most other wagons.

Malibu was quietest of the group, and also did well in track testing. It was fastest in the handling test, tied LeBaron for the best hot-brake panic stop, and tied Concord for fastest time in the maneuverability test.

Chrysler LeBaron

The LeBaron Town and Country, the flagship of Chrysler's wagons, is the most luxurious car in this group. It shares the same body with all other Chrysler wagons—Diplomat, Aspen, and Volare—and is also the biggest, heaviest wagon in the test.

Its driving position is quite good, and is somewhat less flattened out than the Malibu's. Seating comfort is also very good and the plush velour upholstery really does an excellent job of keeping you from sliding around on the seat.

Since LeBaron is the largest car in the group, it isn't surprising that many of its interior dimensions are the roomiest. Like the other wagons, comfort and convenience options can

bring LeBaron up almost to luxury limousine standards.

The 225-cu.-in. six in this car is a trifle undersize and makes LeBaron a slow performer. Its 20.9-second timing from zero to 60 mph is the slowest in the group, marginally slower than the Malibu. At the lowest speeds and from a stop, however, LeBaron seems liveliest, due to clever gearing choices. Above those speeds, though, it's as flat as Malibu and Fairmont.

Ride comfort is the best in the group, just edging out Malibu. In interior quietness, handling, and maneuverability, though, LeBaron isn't up to the others, partly because of the 400–800-lb. weight penalty it carries—which also dragged down its fuel economy.

Steering sensitivity, surprisingly, seemed better than the Malibu's and almost equal to Fairmont's. Our car was almost completely rattle- and squeak-free, but, like the others, there was a bit more thumping from the P-metric tires.

Ford Fairmont

Fairmont is the newest midsize wagon, and is the best contemporary example of efficient space utilization in a front-engine/rear-drive car. It's only two inches longer than the Malibu, but it has about 10 percent more cargo volume. It is also more than 400 lbs. lighter, a bit quicker, and can deliver slightly better economy at highway speeds.

Its interior is roomy enough for four adults to ride in comfort, five with a little crowding, and maybe six if you do some stuffing. Seating is comfortable, with a driving position perhaps more upright than in some of the others, although equal in comfort and layout.

The "flag" style rearview mirrors are neatly faired into the fronts of the vent windows. Adjuster levers are mounted right on them, rather than a couple of feet away, which makes for quick, positive adjustments. The vent panes open precisely and surely by rotating adjuster knobs, just like some expensive European cars.

The heater/air-conditioner controls are tidily grouped to the right of the instrument panel, but are too far from the driver for comfort. In our car, the heater was hard to regulate at low and moderate settings, although maximum output was quite good in cold weather.

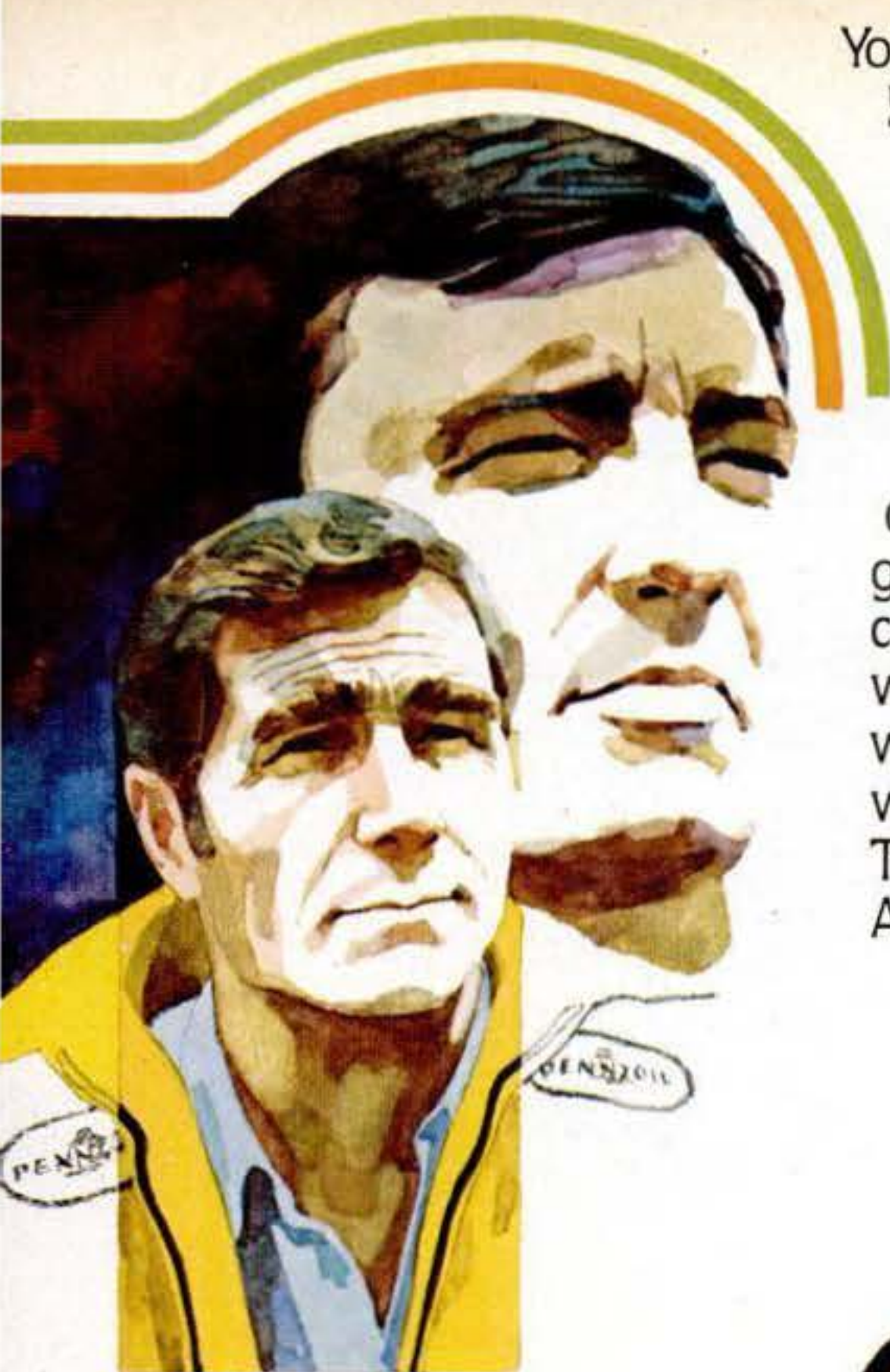
Visibility is excellent, and parkway ride and handling are both good. There is a bit more "feel" in the steering—a rack-and-pinion system where

Continued



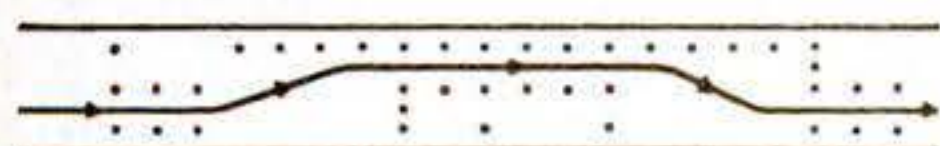
Spare-tire stowage is under rear floor in all four wagons. High-pressure temporary spare in AMC Concord (top) is set well to left, leaving sizable space for hidden storage. Chevrolet Malibu (center) has smaller, right-side hatch, with less-usable storage. Chrysler LeBaron's centrally mounted spare leaves smaller spaces around its perimeter. Ford Fairmont (not shown) has centrally mounted spare, no hidden storage.

You get one shot at it once a year: the Indy 500. So race car designer-builder Jim Hall goes all out. He's got two-time Indy winner Johnny Rutherford behind the wheel of his famed Pennzoil Chaparral. Rutherford and a \$40,000 Cosworth engine make it go. And a motor oil that does all an oil can do, helps keep it going. The oil? Pennzoil. Because you don't take chances when you have the chance to win. Besides, who wants to wait until next year? Pennzoil. There's one for your car. Ask for it.



**YOU DON'T TAKE CHANCES
WHEN YOU HAVE THE
CHANCE TO WIN.**





High-speed handling is checked in fast double lane-change. All four cars are seen veering back into right lane, near end of

test grid (see diagram at left). Malibu turned in fastest speed (far left, above), displayed only moderate body roll. Fair-

the feel is desirable for safer driving. Our one complaint about the power steering is that turning the steering wheel to full lock loaded the system and stalled the engine.

The Fairmont seemed bouncier and

choppier over rough sections than the others and had some tail skittering. It never really got to be a problem, though.

The Country Squire interior is comfortable and pleasant looking, but it's

not as elaborately decorated or visually appealing as the others.

The instrument panel had only a speedometer and fuel gauge, with all other functions monitored by warning lights. The low dash is designed to aid

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Clear, rippling waters. And
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That's satisfaction.**

Warning: The Surgeon General Has Determined
That Cigarette Smoking Is Dangerous to Your Health.

KING: 16 mg. "tar", 1.1 mg. nicotine, 100's: 20 mg. "tar", 1.4 mg. nicotine, av. per cigarette, FTC Report DEC. '79.





mont appeared to corner flatter (left center), but couldn't match Malibu. LeBaron also appeared to corner flatly (right cen-



ter), but was slowest. Concord tied Fairmont for second fastest speed (far right), showed moderate body roll. Steering re-

sponse, cornering power, and emergency evasive capabilities are among the factors examined in this test.

forward vision and to give a feeling of spaciousness, but some drivers may find that the instruments are set too low for quick reference.

The rear hatch is as easy to use as the others, and is much more conve-

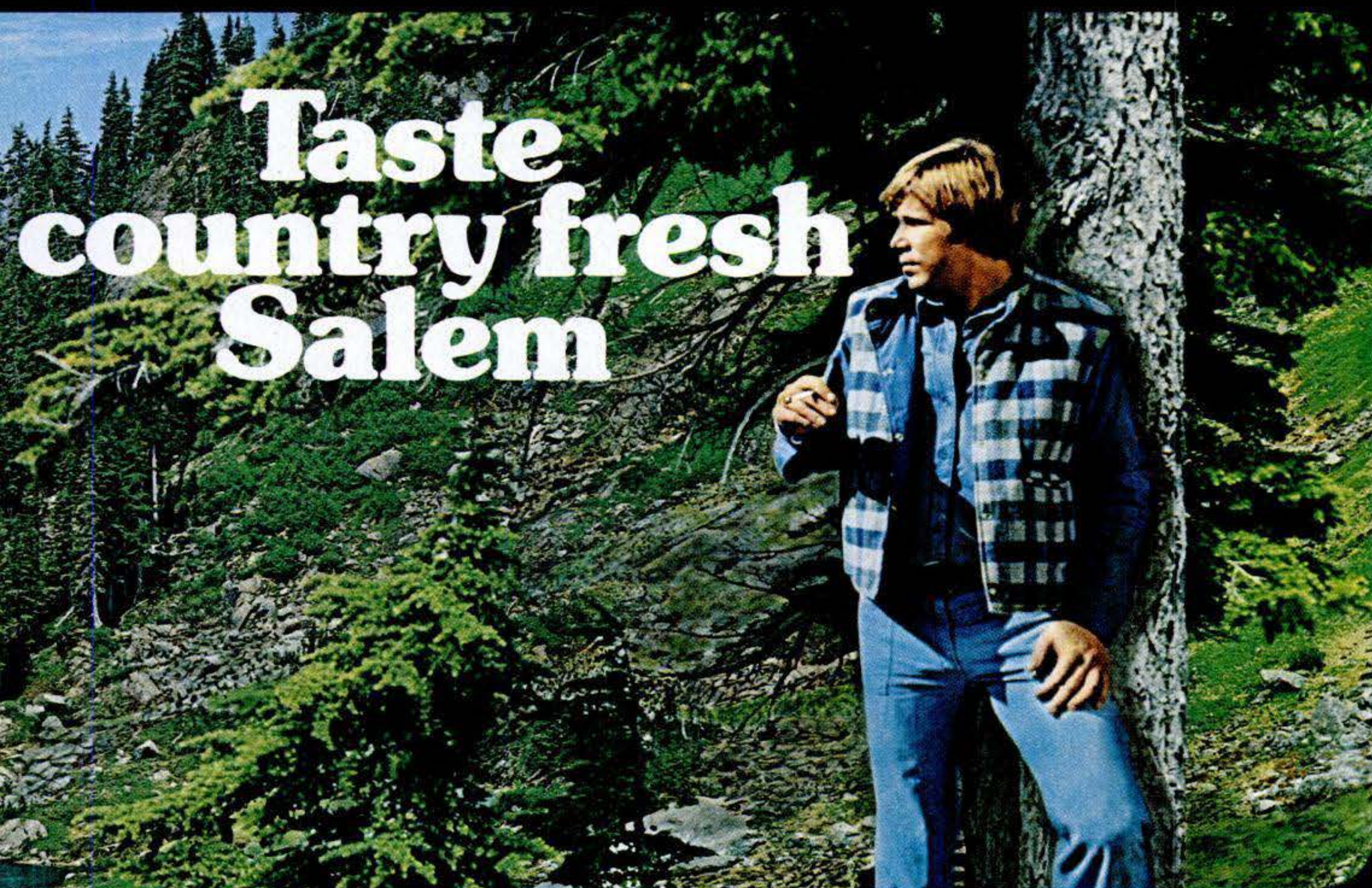
nient than the Malibu's split design. The load floor is flat, and is restricted only by the normal intrusion of the fender wells.

Fairmont won only our cold-braking tests, but was close to the best in

nearly all other tests and is about the best all-around in interior measurements. That adds up to a pretty good package, even if it does fall a bit short on luxury.

PS

For specs and test results, turn page





INTRODUCING THE DATSUN OF 4-WHEEL DRIVE



Grab your gear — the first 4x4s by Datsun are here! With the biggest choice of compact 4-wheel drive truck bodies in America.

TOUGH IN THE ROUGH, SMOOTH ON THE ROAD

Datsun takes 4-wheel drive where the competition's never been. With the highest minimum ground clearance in the class. Solid steel plates to protect underbody parts. A powerful overhead cam engine. A separate high/low range 4x4 transfer stick. And enough built-in tough to tame the roughest road.

But there's plenty of beauty in the beast, too. The new Datsun 4x4s have independent front suspension and big 15-inch wheels to glide you in road-smoothing comfort.

ROOMIEST COMPACT 4-WHEELER IN HISTORY

The Datsun King Cab 4x4 has over 7.1 cubic feet of inside storage space — and optional jump seats inside! Now check out the standards: reclining buckets, tachometer, trip odometer, flip-out rear side windows, flip-down cargo light and the only standard 5-speed in the class. No 4x4 can treat you more like a king!

And if you're looking for a long bed, Datsun's the longest in the class with over 7 feet of cargo length.

REMINDER: BE GOOD TO YOUR LAND

Rugged as the new Datsun 4x4s are, it's important to respect the natural beauty of our wilderness land. Use 'em on the off-road roads, and in designated rec vehicle areas. That'll keep us all truckin' for a long time to come.

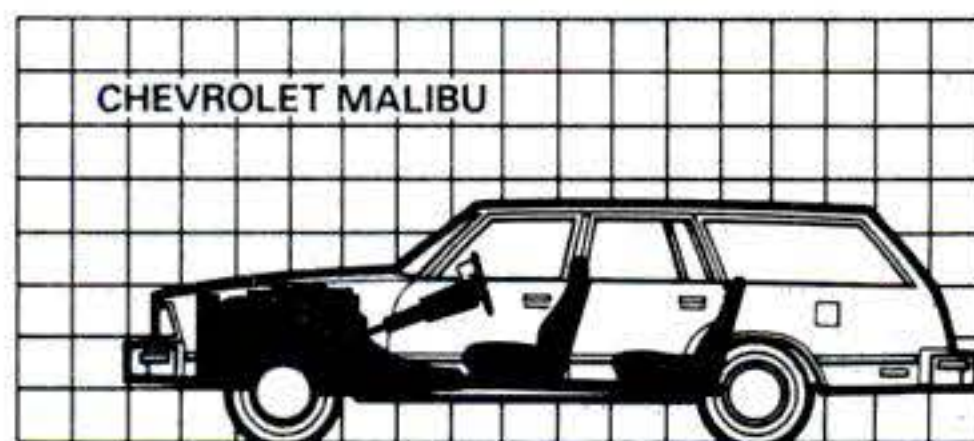
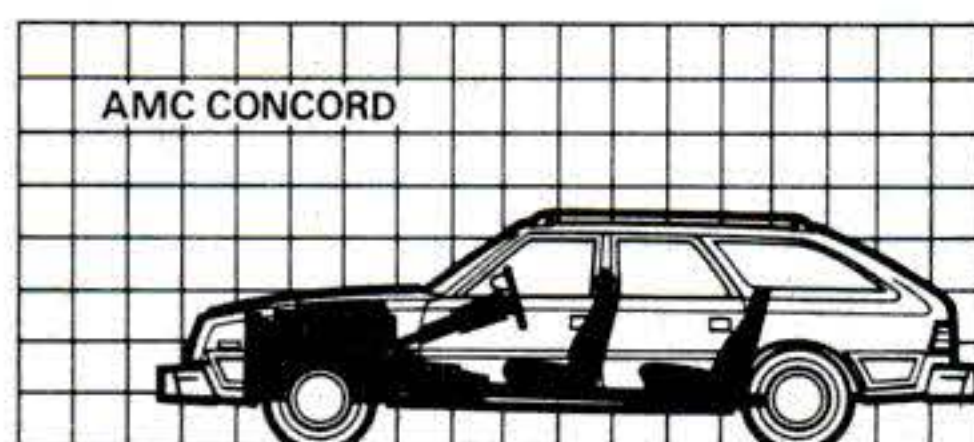
Visit your Datsun dealer, and test drive the hottest 4 wheels in America today — the 4x4s by Datsun!

DATSUN

WE ARE DRIVEN

Some items shown are owner-installed custom options.





Contemporary midsize station wagons are smaller, lighter, reasonably roomy, and more fuel-efficient than their predecessors, even though all still use older, front-engine/rear-drive configurations.

PS serviceability ratings

How easy is it to service these cars? To give you an approximation of how difficult it is for a typical person to perform various service operations, we examine each test vehicle. The numbers mean: 1, very difficult; 2, difficult; 3, average degree of difficulty; 4, easy; 5, very easy.

	AMC Concord	Chevrolet Malibu	Chrysler LeBaron	Ford Fairmont
Checking fluid levels:				
Battery	5	5	4	5
Master cylinder	4	5	4	4
Windshield washer	5	5	5	5
Engine oil	4	3	4	3
Coolant	5	5	5	5
Checking the engine:				
Spark plugs	5	2	3	4
Distributor	4	3	1	3
Carb adjustment	3	*	4	3
Oil filter	3	2	1	3
Oil fill	3	3	3	3
Replacing hoses:				
Upper radiator hose	5	4	5	5
Lower radiator hose	3	3	3	3
Heater hoses	4	4	3	2
Changing bulbs:				
Headlights	3	3	3	3
Taillights	2	3	3	3
Front running lights	3	3	3	3
Front parking lights	3	3	4	3
Front directionals	3	3	4	3
Rear directionals	2	3	3	3
Rear running lights	2	3	3	3
Checking fuses:	3	3	4	3
Spare-tire accessibility:	4	4	4	4
Changing belts:	3	3	3	2
*Sealed				

AMC Concord, Chevrolet Malibu, Chrysler LeBaron, and Ford Fairmont—dimensions, specs, test results

	AMC Concord	Chevrolet Malibu	Chrysler LeBaron	Ford Fairmont
DIMENSIONS (inches)				
Wheelbase	108.0	108.1	112.7	105.5
Overall length	185.0	193.4	205.5	195.5
Overall height	52.6	54.5	55.5	54.4
Overall width	71.0	71.2	74.2	71.0
Track, F/R	57.6/57.1	58.5/57.8	60.0/59.5	56.6/57.0
Ground clearance	6.5	7.3	7.8	6.22
Front head room	38.1	38.5	39.2	39.0
Front hip room	54.4	52.2	56.8	56.2
Front leg room	40.8	42.8	42.4	41.7
Rear head room	37.9	38.5	38.7	38.9
Rear hip room	53.6	55.6	56.6	55.2
Rear leg room (min.)	36.1	35.9	37.4	35.3
Rear knee room (min.)	0.0	0.5	1.9	1.6
Couple distance	31.2	31.1	33.8	33.0
SPECIFICATIONS				
Engine type	I6	V6	I6	I6
Displacement (cu. in./L)	258/4.2	229/3.8	225/3.7	200/3.3
Compression ratio	8.3:1	8.6:1	8.4:1	8.6:1
Carburetion	2-bbl.	2-bbl.	1-bbl.	1-bbl.
Net hp @ rpm	120 @ 3600*	110 @ 3800	90 @ 3600	95 @ 4200
Net torque @ rpm	210 @ 1800*	190 @ 1600	160 @ 1600	152 @ 2200
Transmission	Three-speed automatic	Three-speed automatic	Three-speed automatic	Three-speed automatic
Axle ratio	2.53:1	2.73:1	2.73:1	2.73:1
Tire make	Goodyear	Goodyear	Goodyear	Firestone
Tire type	Custom Polysteel radial	Custom Polysteel radial	Custom Polysteel radial	721, steel-belted radial
Tire size	P195/75R14	P195/75R14	FR78-15	P185/75R14
Steering	Recirculating-ball, power	Recirculating-ball, power	Recirculating-ball, power	Rack and pinion, power
Overall steering ratio	17.0:1	17.5:1	18.7:1	20.0:1
Turns, lock to lock	3.0	3.3	3.5	3.1
Turn diameter (ft.)	34.9	37.2	40.7	39.0
Front suspension	Independent, unequal-length control arms, coil springs	Independent, single lower control arms, coil springs	Independent, lateral non-parallel control arms, transverse torsion bars	Independent, hybrid MacPherson w/coil spring on lower control arm
Rear suspension	Solid axle, Hotchkiss, semi-elliptical leaf springs	Solid axle, Salisbury, four-link, coil springs	Solid axle, Hotchkiss, semi-elliptical leaf springs	Solid axle, four-link, coil springs
Front stabilizer-bar diameter (in.)	None	None	None	None
Rear stabilizer-bar diameter (in.)	None	None	None	None
Trailer towing (max. lbs.)	2000	5500	2000	1500
Trailer tongue weight (max. lbs.)	200	650	200	150
Brakes	Disc/drum, power	Disc/drum, power	Disc/drum, power	Disc/drum, power
Brake swept area (sq. in.)	326.8	307.8	355.0	301.6
Fuel tank (gal.)	16.5	18.2	18.0	14.0
EPA cargo volume (cu. ft.)	57.0	71.8	71.8	79.5
Liftover height (in.)	24.2	24.4	22.9	28.6
Curb weight (lbs.)	2816	3282	3616	2801
F/R weight distribution (%)	52/48	50/50	52/48	52/48
Basic price	\$5177	\$5653	\$7112	\$4721
Price as tested	\$8190	\$8778	\$9420	\$6976
Major options on test car	A/C \$734, 258 engine \$180, auto. trans. \$383, white-wall tires \$149, power windows and door locks \$289, AM/FM stereo \$236, cruise control \$104	A/C \$601, power door locks \$132, power windows \$202, two-tone paint \$123, cruise control \$112, auto. trans. \$358, power steering \$174, gauge package \$134, AM/FM stereo \$192, power seats \$244	A/C \$626, power door locks \$136, wire wheel covers \$260, power seats \$212	A/C \$571, auto. trans. \$340, 3.3-liter engine \$169, Country Squire package \$458, rear defroster \$101, AM/FM stereo \$183, power windows \$191

TEST RESULTS

Acceleration (sec.)				
0-60 mph	16.0	20.5	20.9**	18.7
25-70 mph	18.0	23.3	26.9**	22.6
Brake test (cool) 60-0 mph				
Stopping distance (ft.)	173	159	136**	131
Pedal pressure (lbs.)	105	150	130	90
Disc temperature (°F)	128	125	190	158
Brake test (hot) 60-0 mph				
Stopping distance (ft.)	164	147	147**	169
Pedal pressure (lbs.)	180	180	90	160
Disc temperature (°F)	566	515	632	452
Interior noise @ 60 mph (dBA)	68	65	69	70
Handling test (mph)	58.2	60.0	56.3	58.2
Maneuverability test (mph)	29.1	29.1	26.8	28.1

TEST CONDITIONS: Ambient temperature, 47 °F; relative humidity, 58 percent; barometric pressure, 29.89 inches Hg
*Estimated **Measured manually

Performance comparison with selected models

	Mpg (city driving)	Acceleration 0-60 mph (sec.)	Brakes 60-0 mph (hot) (ft.)	Handling (mph)	Maneuverability (mph)	Noise @ 60mph (dBA)
1978 Mercury Zephyr wagon V8	16	12.0	216	*	*	72
1978 Chevrolet Malibu wagon V8	16	12.9	127	*	*	70
1978 Plymouth Volare wagon V8	15	14.1	155	*	*	71
1979 Ford Fairmont 6	18	15.9	149	62.4	26.8	68
1979 AMC Concord 6	17	13.4	152	56.3	28.1	67

*Not tested; track covered by snow.



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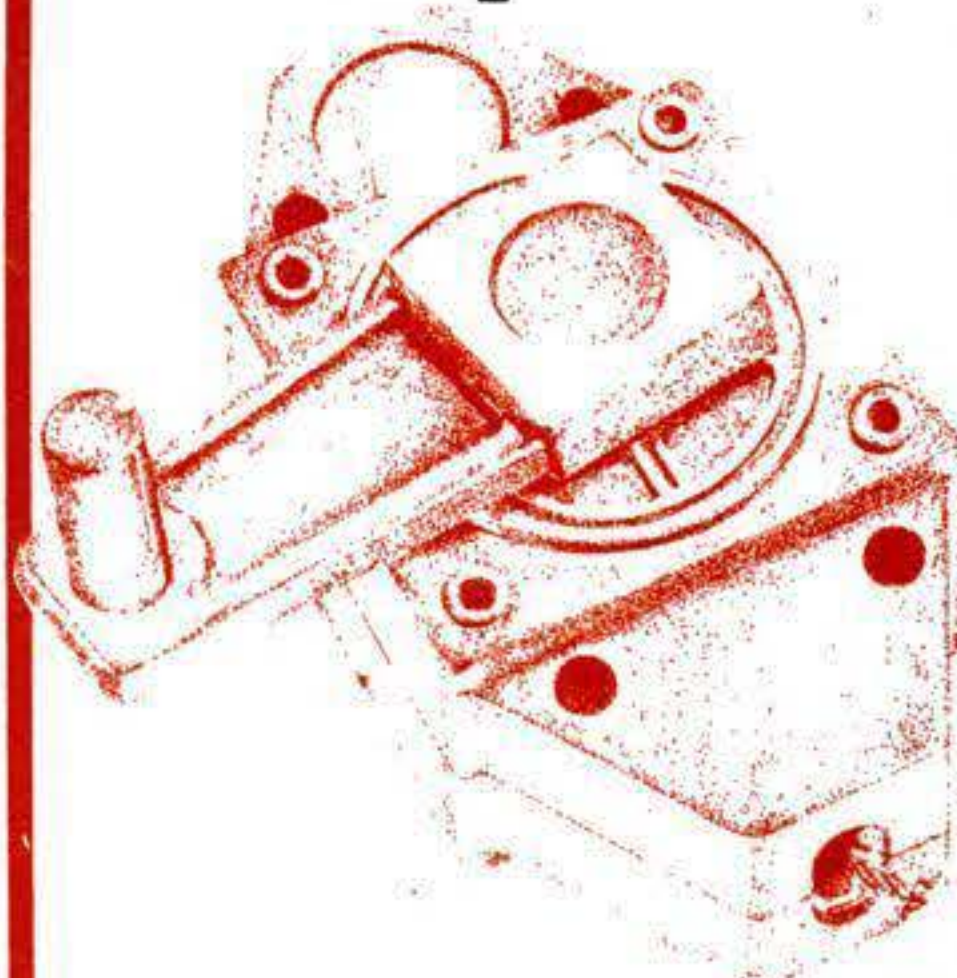
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LONDON, ENGLAND

The Sinclair ZX80 costs only \$200, yet it has the performance of units two or three times as expensive, the maker claims. A reduced number of parts and simplified construction help keep the price down, Sinclair says. One big cost cutter is a touch-sensitive keyboard. The standard alphanumeric layout provides single-stroke entry of 22 commands and statements such as RUN, INPUT, and PRINT. No shift is needed, since these key words follow a line number and are anticipated.

Aside from eliminating some tedious typing, this relieves the Random Access Memory (RAM) of that function. Thus a small, cheap 1K RAM can do the work of 4K bytes in other computers. Another advance is a single powerful Read Only Memory (ROM) containing the basic language interpreter, character set, operating system, and monitor. The Z-80 microprocessor handles the video display for the first time on a single chip.

The 12-ounce ZX80 has no video console, but plugs into the antenna socket of any color or black-and-white TV for monitoring. The display is black on white for unusual clarity, and consists of 24 lines of 32 characters each.

Every statement line is entered at the bottom of the screen, where it is automatically checked for syntax, with any errors identified by a special marker so they can be corrected. Only faultless lines can be added to the program list at the top of the screen.

An ordinary cassette player stores programs. The British company has some prerecorded ones, and U.S. software is also acceptable. A printer and extra memory capacity are also available. Other languages are planned, with changeover made easy by a flexible overlay for the touch keyboard.

For more information, write to Sinclair's U.S. office, 50 Staniford St., Boston, Mass. 02114.—David Scott

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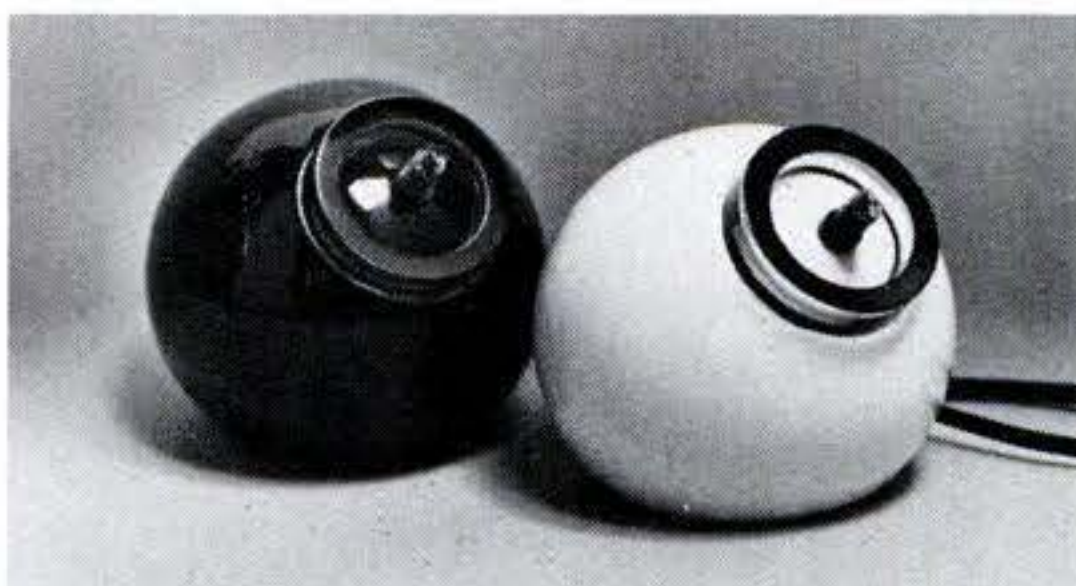
by creating a negative electrical field. One 4-inch unit will ionize up to 250 square feet, or an average 12' x 20' room. This negative charge acts on floating particles—even invisible ones—causing them to cluster, fall to the floor or adhere to nearby surfaces. The air becomes pure, feels almost "washed." And Ionosphere is so efficient it requires no fan or other moving parts to disperse these ions.

You probably have experienced this fresh-air feeling before. In nature, negative ions are continually recreated by the dynamic action of the sun, rain and lightning. It's why air smells sweet and invigorating after a thunderstorm, or deep in a forest.

Born in academia.

Major ion research has been conducted at the University of California, Berkeley. Ion Systems, Inc., a private company, was founded to manufacture ionizers to the rigorous standards of this research community. Headed by senior engineer D.A. Gehlke (formerly with the government's Polaris Project), I.S.I. has built almost every hospital ion system in the U.S. Their new portable Ionosphere is constructed with this same level of integrity.

Ionosphere's electronics are both superb and unique. It is the only ionizer that uses "passive multi-stage" circuitry for its noiseless and noninterfering output (many units are known to affect radio reception). Most other units use a "vibration" mechanism, which causes clicks, pops or an annoying high-pitched whine.



Power use: approximately 3 watts. Total ion output: 3.8×10^{12} ions/sec. Ion density: 10,000 ions/cubic centimeter at 8'. Ozone production: less than .03 ppm. N_2O production: not measurable.

The circuitry is embedded in epoxy resin, then encapsulated in an impact-resistant sphere—a solid seamless ball of fine ceramic tile. Hermetically sealed, it is protected from the moisture that inevitably reduces the performance of competitive units.

We know of no other company that takes

such pains in producing their product.

Other significant differences? For one, a vastly superior ion emitter than you'll find elsewhere. This easily removable element is made from surgical stainless steel bristle, not the more commonly used copper "fuzz" or nickel-plated points. (These have short life spans, do not clean easily, and in short time lower their output.) The Ionosphere's emitter will last a lifetime, and cleans easily under hot water.

On other units, you'll also find inexpensive plastic cases. When exposed to a high voltage field, these petrochemicals can be converted to a harmful gas. But Ionosphere's tile case is completely safe.

More ions aren't necessarily better.

One 4" Ionosphere generates approximately 3.8 trillion ions every second. Unlike other units which produce an excessively high output (at the source only), the Ionosphere creates a more *naturally* balanced ion environment. You should also avoid units without stated levels of ozone production (Ionosphere is among the lowest).

Why do we need ionizers at all?

Urban life has upset the natural electrical balance of the air. Modern conveniences like heating, air conditioning, telephones and televisions greatly deplete negative ion levels, robbing the air of its natural cleansers. This is also why we feel uncomfortable under fluorescent lights.

Ionosphere restores this balance in just minutes. The air smells good again, even after smoking.

And, as a result of its work, you may need to clean your walls in a year or so. But be glad that same soot was kept out of your lungs.

Try one, or order a system.

The \$89 Ionosphere comes in white (#946) or black ceramic (#945). Or you may expand your fresh air environment at an \$18 savings—with three units at \$249; 2 white, one black, (#947). Either way, you can experience the freshest air you've probably ever breathed, without obligation. Ionosphere comes with full instructions and a one year warranty. And if you're not delighted, simply return your order within two weeks for a prompt and courteous refund.

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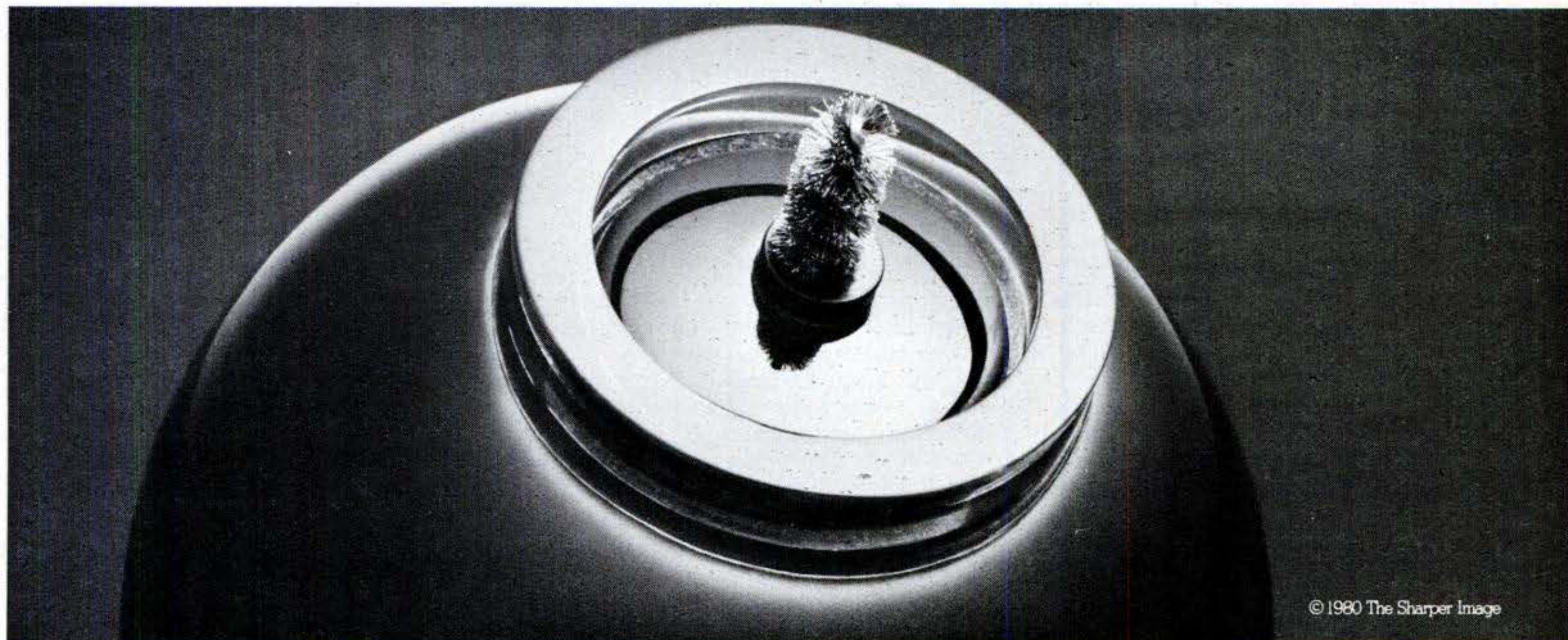
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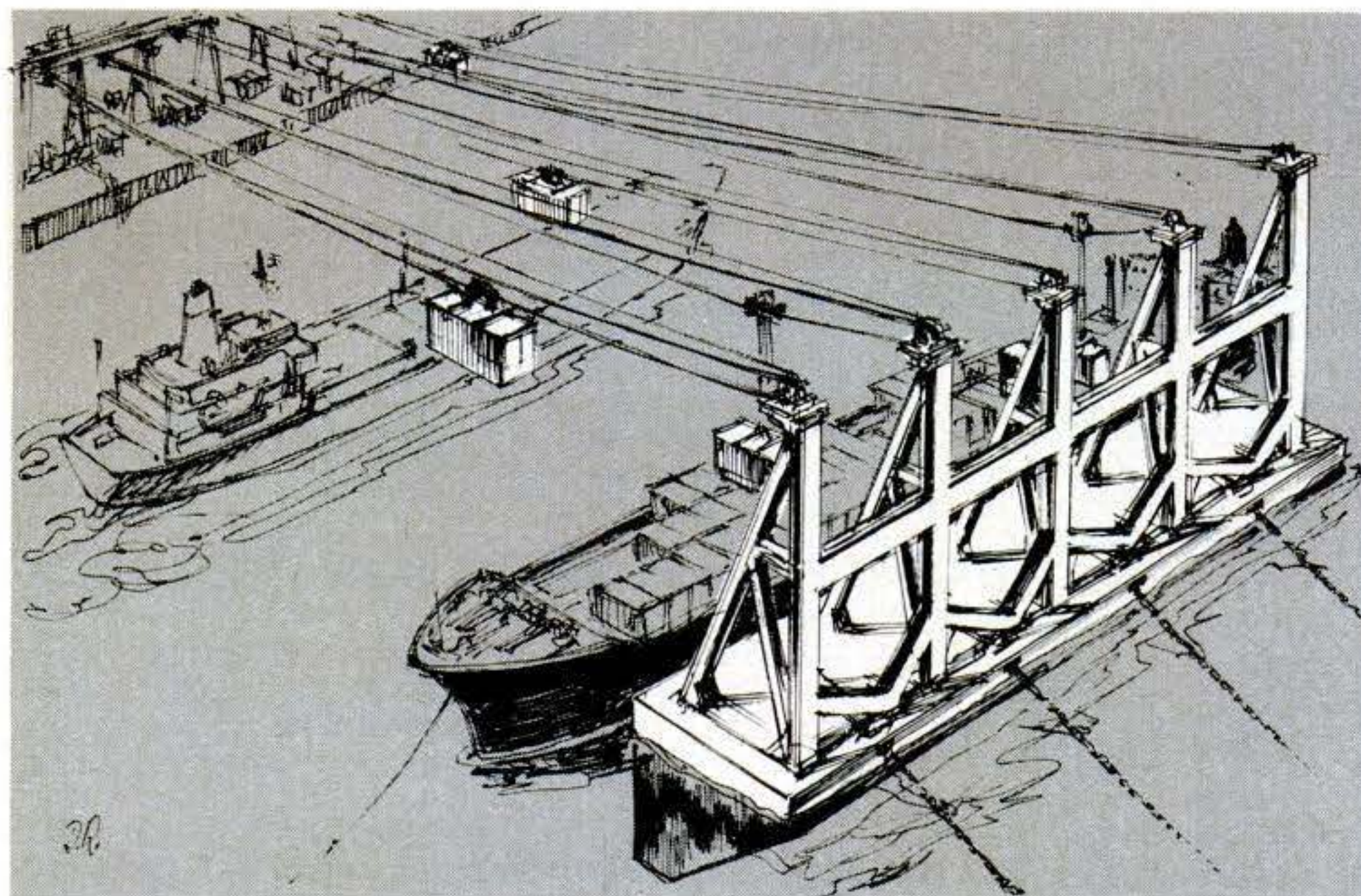
THE AIR IONIZER WITH THE SCIENTIFIC EDGE.



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NEW IDEAS FROM THE INVENTORS

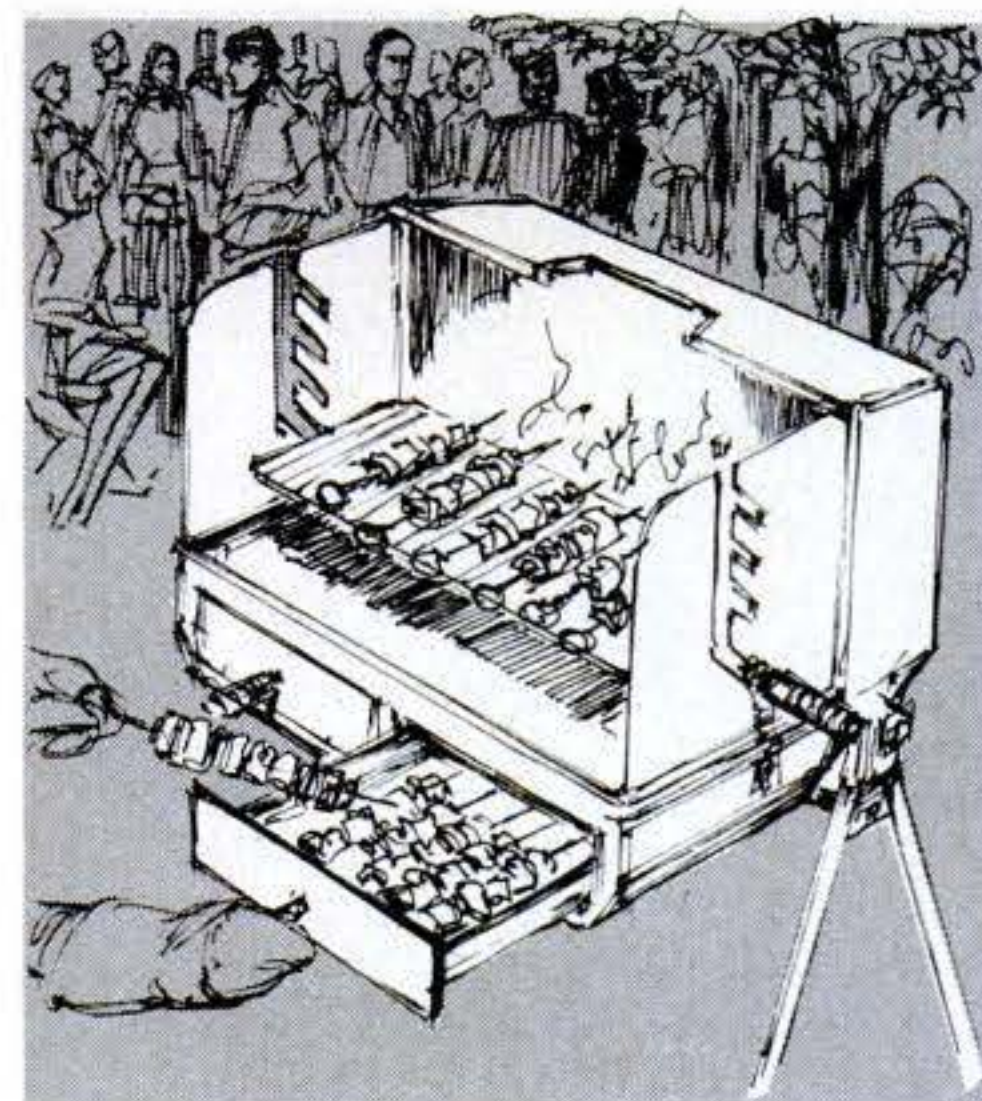
ILLUSTRATIONS BY DANA RASMUSSEN



Pontoon-supported cables load ships offshore

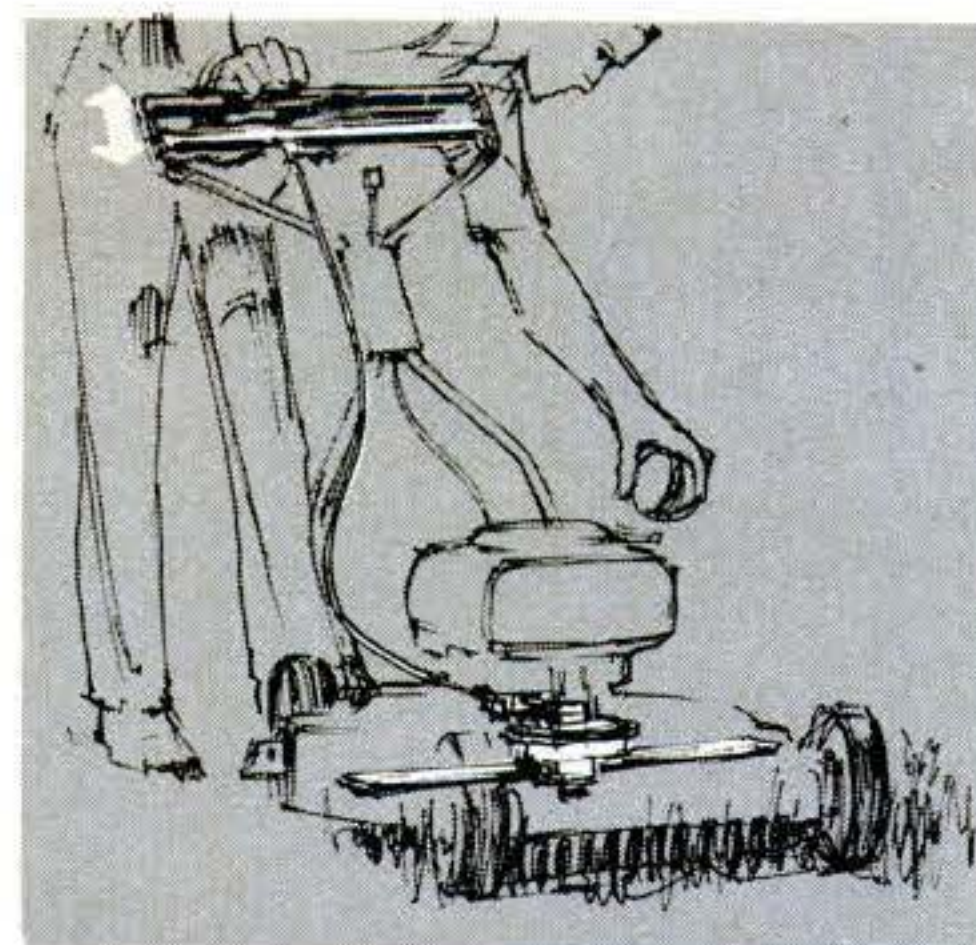
A set of aerial tramways, with cables running between shore points and offshore towers, might speed the loading and unloading of containerized or general cargo at crowded ports, while making the movement of deep-draft vessels less dependent

on tides. These load-supporting, continuous-loop cables would be counterweighted at the land end and tensioned offshore by the shape of this asymmetrical pontoon. Its hull displacement would be greater on the landward side.



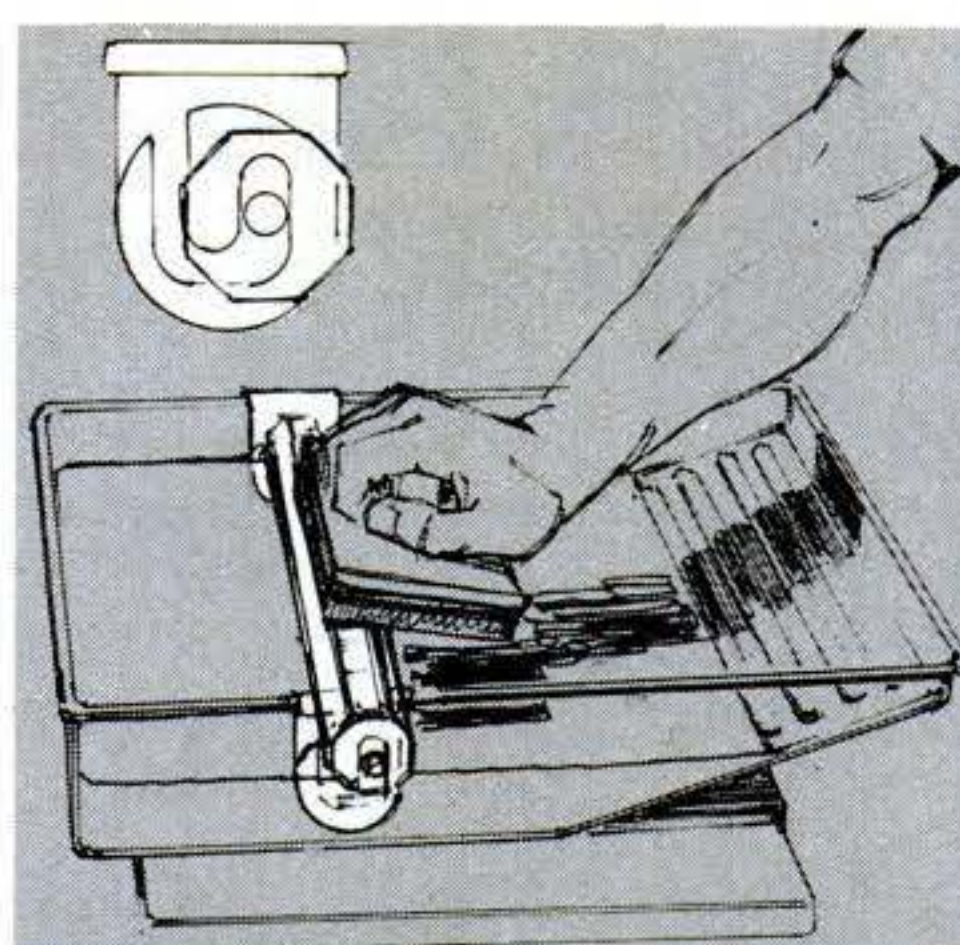
Grill drawer keeps food warm

Pivoted to shift the firebox from horizontal to vertical spit-holding service, this portable camp or patio cooker would let you serve hot food to all your guests at the same time. If a large party required you to cook in shifts, you'd place the first-grilled batch in a drawer and store it below or behind the grease pan, where it would keep warm until the whole meal was ready for serving.



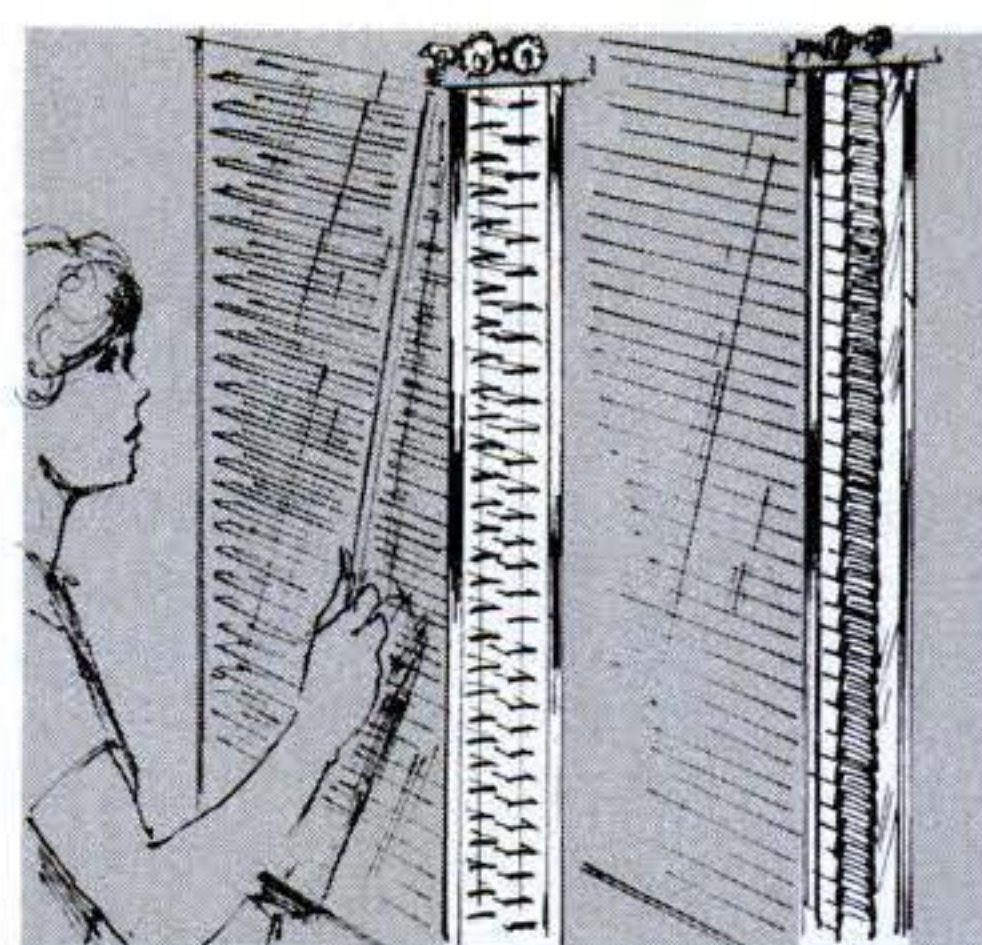
Switch uncouples mower blade

Tens of thousands of injuries are said to be caused each year by misused, dropped, runaway, or otherwise out-of-control power mowers. Many accidents might be prevented by this deadman's switch. You'd have to grip the bar lever in the handle to run the rotary mower; releasing the handle would automatically disconnect the clutch and set a brake.



Floating roller loads paint pad

Flat, napped pads are convenient paint applicators, but can be wasteful when overdipping causes an uneven or too-thick coat. Installed crosswise in a standard tray, this buoyant roller would adjust its height in J-slotted brackets as the paint level changed. The flattened roller faces would maintain a selected surface exposure to transfer uniform paint loads.



Blind cuts heat loss

Some experts claim that heat loss through a double-pane window could be cut almost in half by the inclusion of a third pane. To obtain a similar effect at lower cost and with greater convenience, these inventors would sandwich a tight-fitting, double-slatted blind between two panes. When closed, it would create three dead-air spaces with improved insulation.

The following patents have been issued on these inventions: **Ship loader**—No. 4,106,638 to H. Negre, Paris, and J.-P. Cathiard, Noyarey, France; **Safety mower**—No. 4,158,944 to J. Rabinow, Bethesda, Md.; **Paint dipper**—No. 4,106,434 to E. Vines, Wellesley, Mass.; **Grill warmer**—No. 4,106,473 to S. Wandel, Bremen, W. Germany; **Heat-saving blind**—No.

4,076,068 to J. Archer, Nyashamn, H. Larson, Vasterhaninge, Sweden. Copies of patents may be ordered, by number, from the Commissioner of Patents, Washington, D.C. 20231, at 50 cents each. To write to an inventor, if address above is insufficient, address him by name and patent number in care of the Commissioner.

New from Stewart-Warner

Mini-Panel

The world's smallest instrument panel alerts you to car problems before they cause costly damage.

Mini-Panel is the miniaturized early warning system that enables you to spot problems that may be developing while you drive. (Unlike traditional warning lights that don't go on until it's too late.) Catch those problems early, and you'll save yourself a lot of grief, as well as major expense.

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ALTERNATE-ENERGY ANSWERS

By JAN F. KREIDER

Jan F. Kreider is a consulting engineer specializing in the design and economic analysis of solar-energy and energy-conservation systems. He is the author of several books on solar technology, and a lecturer at the Univ. of Colorado.

Underground cooling

I'm interested in supplemental heating and cooling of our desert home by venting air into the home from an underground piping system. Can you help us determine the amount of air flow and piping required for such a system?

Joyce E. Mount, Alamogordo, N. Mex.

Is there any simple means to calculate the size and length of pipe necessary to provide a satisfactory system of cooling and heating outside air by means of pulling it through a length of buried pipe?

John C. McLaughlin, Duluth, Minn.

Yes. The amount of heat transferred between earth and air in a buried pipe can be calculated relatively easily if you make a few assumptions about the heat-flow mechanism. The heat-transfer Q in Btu/hr can be figured by this equation:

$$Q = (0.07 L) \times \frac{T_{in} - T_{out}}{\log \left[\frac{T_{earth} - T_{in}}{T_{earth} - T_{out}} \right]}$$

The pipe length is L , the air inlet temperature to the pipe is T_{in} , the outlet temperature is T_{out} , and the constant earth temperature is T_{earth} . The logarithm (base 10) can be looked up in your old algebra book or read from a calculator. If you know the energy requirement Q , the equation can be used to find the pipe length L .

To maximize the heat transfer, a series of short pipes connected in parallel to a header should be used rather than a single, very long pipe.

Winter swimming-pool heating

We recommend swimming for our asthma patients in order to build up their lung capacity and improve the body's ability to use oxygen more efficiently. But in Florida unheated pools can be used only five to six months annually; average pool temperature in winter is 65 degrees F. Minimum temperature needed for asthma patients is 78–80 degrees F.

Is there any commercially available solar heating system that can generate more than eight to 10 degrees?

Joseph M. Zeterberg, M.D.
Fort Meyers, Fla.

Pools can easily be heated to temperatures of 80–85 degrees F by using flat-plate collectors of the type used for domestic water heating. These collectors differ from the simple ones normally used to heat pools; they use a glass cover for a heat trap and insulation on the rear surface of the collector to reduce heat loss. The size of collector can be estimated by calculating the daily energy loss from the

surface (heat plus evaporation) and through the pool walls (heat only) for a typical day. A solar collector manufacturer can tell you the daily energy collectable under various conditions. Comparison of these two numbers will indicate the size of collector required. The remainder of the system consists of a circulation pump and a valve or two—quite simple as solar heating systems go.

Nighttime cooling

I have read many articles in POPULAR SCIENCE about energy-saving measures. However, I do not believe that PS has ever published an article describing how to use outside air for cooling at night, for homes that have central air conditioning. If it were possible to have the thermostat turn off the compressor at a predetermined setting and open an outside damper, I believe you could achieve a considerable saving at night and on mild days.

J. N. Caldwell, Shreveport, La.

The type of nighttime cooling you suggest is a standard feature of most air-conditioning systems for large buildings. It's usually called the "economizer cycle." Outside air is used for cooling when its temperature is sufficiently low. Of course, there is more to air conditioning than reducing air temperature. Reduction of humidity is equally important and can't always be accomplished by use of outside air. Therefore, the best part of the country for major "economizer" energy savings are those areas where the wet-bulb temperature is low and where large day-to-night temperature swings occur.

Clothes-dryer venting

I've been venting my electric clothes dryer into my home's oil-burning, forced-air heating system during the winter months. Do you predict any problems with the moisture being added to the system?

Steve Rothe, Oconomowoc, Wis.

The exhaust air from clothes dryers can be used to provide heat and humidity to a residence. POPULAR SCIENCE covered dryer heat-recovery devices—both commercially available units, as well as systems readers had devised—in the Nov. '78 issue. One major problem, however, is the flow of very tiny fibers (which pass through the dryer filter) into the living space at the same time. Some experts fear that these fibers could become permanently imbedded in the lungs and possibly lead to cancer. It is difficult to filter out these fine particles without adding an extra pressure drop beyond the capacity of the relatively

small capacity of the dryer's air mover. If the exhaust is restricted by an extra filter, the heating element will overheat and the circuit breaker will open.

DIY solar pool heating

I would like to build a solar collector to heat a swimming pool. Where can I find such plans and list of materials needed?

Gus Raymond, Dallas, Tex.

One of the best publications on this topic is available from the Copper Development Assn., 405 Lexington Ave., New York, N.Y. 10017. Ask for the free booklet "How to Design and Build a Solar Swimming Pool Heater" by Francis deWinter. Even if you don't use copper, the booklet will help with collector design. Another fine 64-page paperback, *Solar Heating for Swimming Pools*, by Doug Root and his colleagues, is available for \$4.50 from the Florida Conservation Foundation, 935 Orange Ave., Winter Park, Fla. 32789.

Previous articles in POPULAR SCIENCE on solar swimming-pool heating include: "Dual-Use Solar Wall: Pool Heat Plus Handball Backboard," Apr. '77; "Solar Heating—How to Pick the Right System for Your Home," July '78; and "Synthetic Rubber Extrusions For Low-Cost Roll-On Solar Collector," June '79.

A/C heat recovery

I have a question regarding the heat produced in the discharge piping of air-conditioning refrigeration systems. Is there enough heat to warrant recovering it by means of a heat exchanger to heat domestic water?

Julian O. Hutten, Seal Beach, Calif.

In most mechanical A/C systems, heat can be recovered from the refrigerant vapor. A heat exchanger to transfer this heat to a water tank is required. If the A/C system uses a centrifugal compressor, there may be insufficient pressure capacity to overcome the added flow resistance of the new heat exchanger. If a piston-type compressor is used, however, there is usually sufficient capacity available.

A large number of resort hotels in the tropics that have cooling loads every hour of the year use this heat-recovery approach to heat all the water needed for the entire year. The payback period is less than two years for these systems. This type of modification is not simple, however; proper attention to heat-transfer principles and refrigerant-system construction is necessary. [Watch for a complete roundup of commercially available waste-heat water heaters in a future issue of PS.]

Got a question on an alternate energy such as solar, wind, water, or wood? Or on energy-conservation techniques that could reduce your home's heating and cooling costs? Every other month, alternating with "Adventures in Alternate Energy," Jan Kreider answers questions selected from those sent in by readers. Write to "Energy Questions," POPULAR SCIENCE, 380 Madison Ave., New York, N.Y. 10017. Queries can't be answered by mail.



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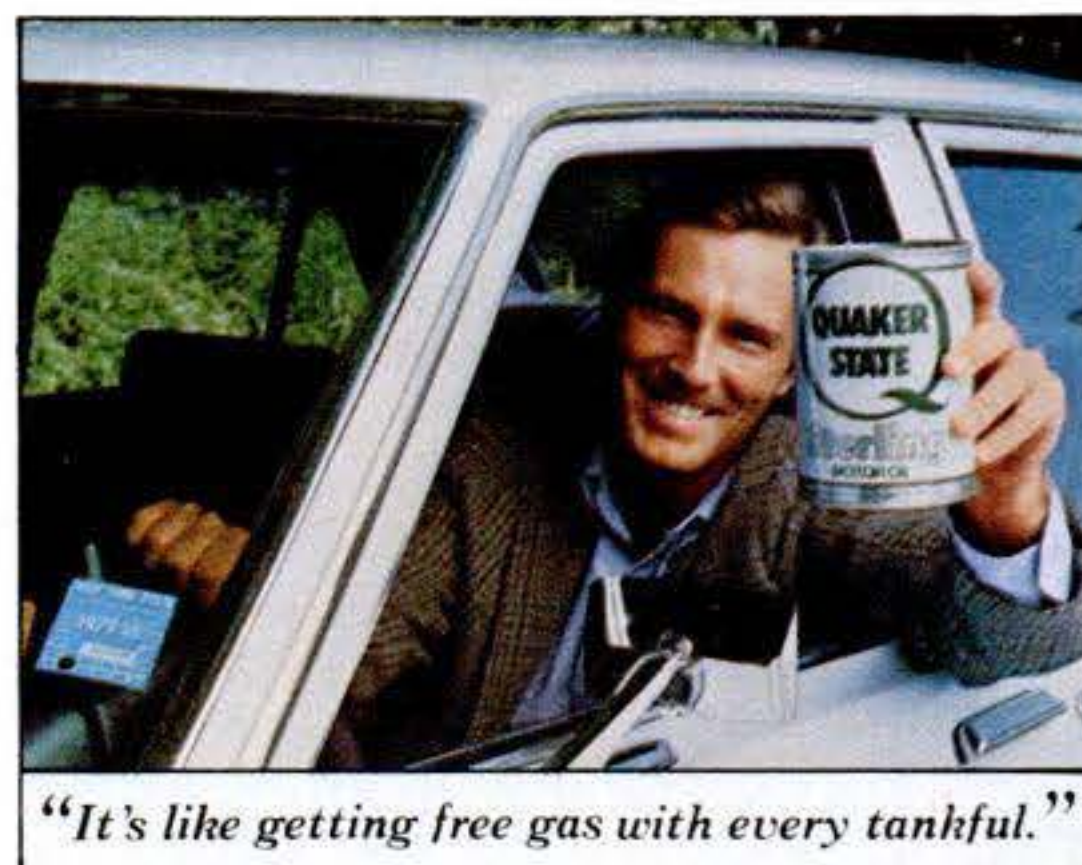
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Like all Quaker State Motor Oils, Sterling can help your car last and help you avoid expensive engine repairs.



"It's like getting free gas with every tankful."

RECREATION ROUNDUP

By HERBERT SHULDINER



Lightweight boat trailering

With the fleet of smaller cars on the road increasing, makers of trailerable boats are engaged in a priority effort to shave weight to meet the lower maximum towing limits of these vehicles. That means more than just reducing boat weights. It also requires lighter trailers.

Glastron has just announced new A-frame aluminum trailers that are designed for the smaller cars. They're 25 percent lighter than steel models, making it easier for owners of small cars to tow boats. The

new trailers weigh only 380 pounds, yet have many wanted features: fenders, waterproof wiring harnesses, and carpeted bunks. The bunks are matched to the hull contours of Glastron's 15- and 16-foot boats, and help guide the boat on and off the trailer at launching ramps. Mag wheels are optional.

A unique feature of the trailer is the absence of a caster jack and wheel. Glastron uses a kickstand instead; it swings up to lock out of the way while you're trailering.

Price of the new trailers is \$1200.

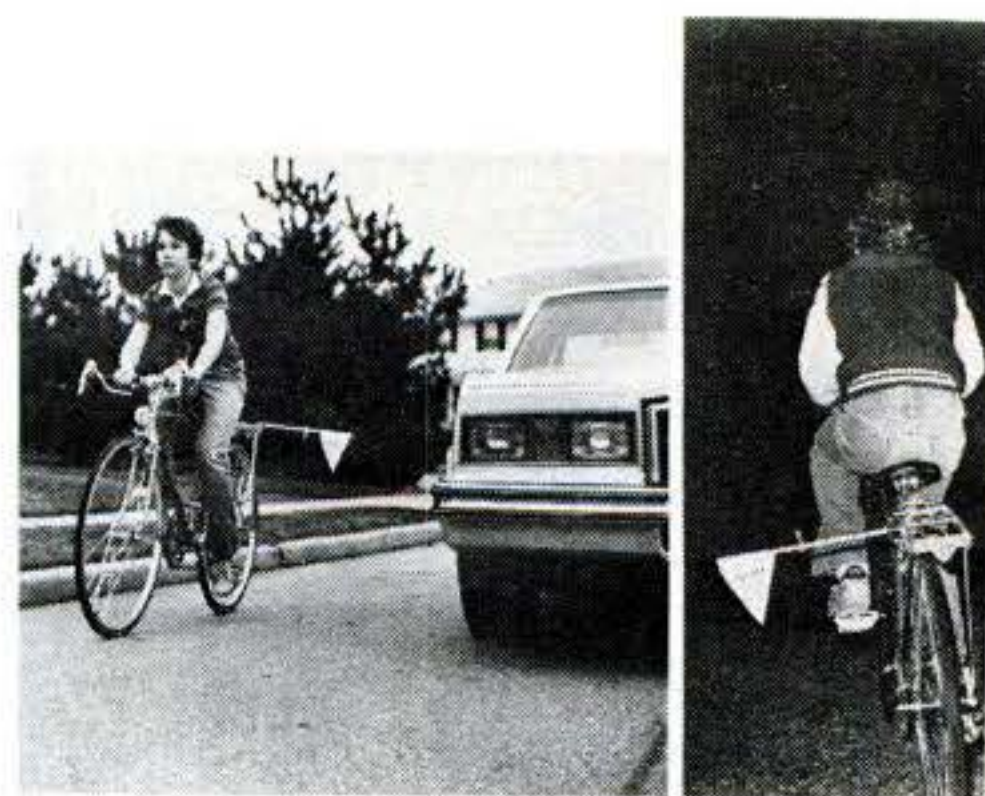


Portable fridge/heater

Car campers may find the new Magic Temp portable refrigerator/heater a great convenience. It uses thermoelectric components to heat or cool. It can hold up to three six-packs, or enough chicken and buns for a family of four, the maker claims. The unit draws four amps for cooling and two amps in the warm mode. It weighs 14 pounds when empty. Made by Fogel/Jordan Refrigerator Co., 5400 Eadom St., Philadelphia, Pa. 19137, it costs \$149.

Bike safety flag

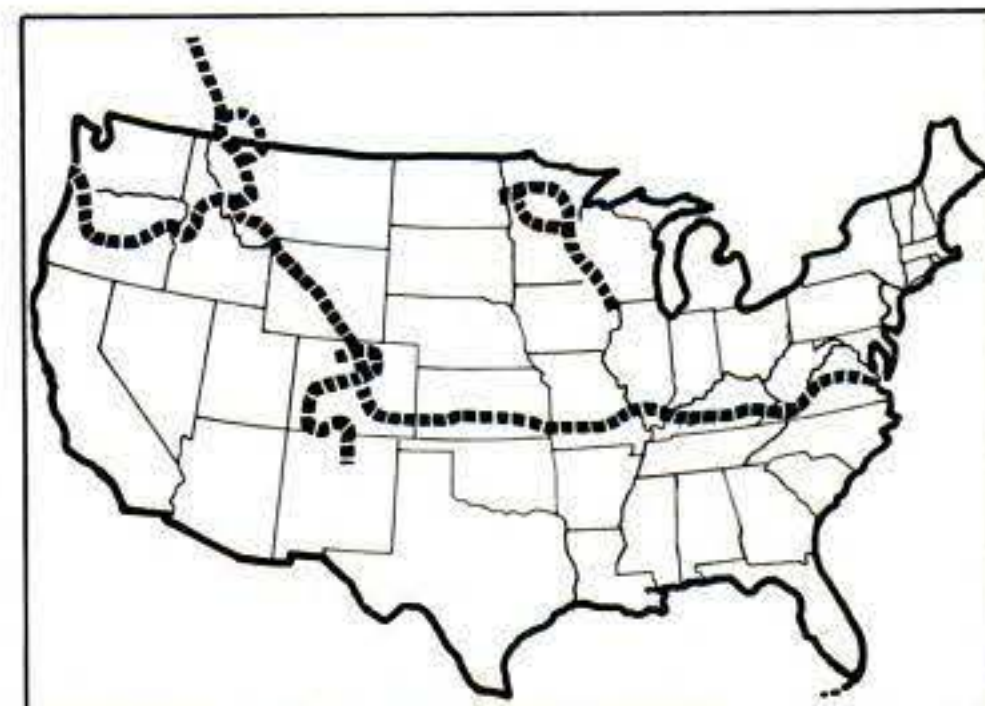
The Dingle is a new reflective safety flag that helps make bicyclists more visible to passing motorists. It extends 17 inches out from the left side of the bike, which is



usually the passing side. It can be seen from as far as 600 feet at night, the maker claims. When the bike isn't being used, the flag folds down out of the way. The Dingle is sold by Dimension Weld Organization, 84 Commerce Rd., Stamford, Conn. 06902. It costs \$5.88 at bike stores.

Pedaling America

If you'd like a slow trip through the U.S. heartland, the Bikecentennial may have just what you're looking for. The six-year-old organization is offering nine tours this summer, ranging from 275 miles (12 days) to 4450 miles (90 days). The tours



consist of eight to 10 bicyclists led by a trained guide.

Routes (shown on map) are designed to take the tours over country or secondary roads whenever possible. Separate bike-ways are not generally used by the group, except in some urban areas. Prices range from \$148 for the 12-day trip to \$1080 for the 90-day trip. The latter is over a cross-country trail from Yorktown, Va., to Portland, Ore.

The tours are detailed in a 20-page booklet, "Bike Back Into America," which is free from Bikecentennial, Box 8308, Missoula, Mont. 59807.

National-park reservations

Seven national parks will maintain a computerized reservation service for this year's camping season. Reservations for campsites at Yosemite, Sequoia-Kings Canyon, Grand Canyon, Rocky Mountain, Shenandoah, and Great Smoky Mountains national parks, and Cape Hatteras National Seashore, can be made in person at Ticketron outlets or by mailing to Ticketron reservation offices (Box 2715, San Francisco, Calif. 94116, or Box 19992, Washington, D.C. 20036). Reservation applications are also available from the individual parks and from the National Park Service.

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Inflates in minutes for luxurious comfort anywhere!

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- On the Boat
- By the Pool
- In the Guest Room

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Siesta Bed of Air provides you with the relaxing, sensuous sleep of a water bed without the fuss and weight! Their revolutionary Tubular Air Coil System automatically equalizes body weight so you don't "sink" and sides won't pop up. Your whole body gets the firm yet gentle support it needs to wake up feeling alert, rested, restored!

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Unlike other air mattresses you may have seen, the Siesta Bed of Air is luxuriously covered with a soothing denim-like Rayon that never feels cold or slick. You'll enjoy complete "at-home" comfort even when you camp out on vacation!

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The Siesta Bed of Air is unbelievably strong—kids can jump and play on it without wear and tear. It's double-sealed by the manufacturer for long, leak-proof life... Siesta's are really built to take it. So, you can take your Siesta along wherever you go and get the sleep you need.

Like having a guest room on a shelf

No place to put up guests? No problem when you own a Siesta Bed of Air! Just inflate it in minutes and provide guests with a luxurious "guest room" anywhere. When they're gone, just deflate it and store it easily on a small shelf! But you may well decide to make your Siesta Bed of Air your permanent mattress. No frame or box spring is required—the Siesta is the all-in-one luxury bed for comfort and unprecedented convenience at home or on the road.



Store your Siesta "Guest room" on a shelf when not in use! Inflate it in minutes when guests arrive—or use it every night for a deep, restful sleep.



Sleep FREE for 30 nights!

We invite you to sleep-test a Siesta Bed of Air for a full 30 nights before you decide a thing. If not convinced that it gives you the most restful, supportive sleep ever, simply return it for a prompt, complete refund.

Available in a variety of sizes

Whether you order Full, Twin, Queen or King, you'll enjoy the sleep of a lifetime! And don't forget to order the Custom Air Pump specially designed for use with the revolutionary new Siesta Bed of Air.

Order Now at these low prices!

A fine mattress has become a very expensive proposition—but not the Siestas! You may own a Twin-size Siesta for just \$59.95, a Full for \$79.95, a Queen for \$99.95 and a King-size for merely \$109.95 plus \$5.95 for shipping and handling—incredible! The Custom Air Pump is just \$29.95.

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(Add \$5.95 shipping and handling per bed)

☐ Also send me the high-powered motorized Custom Air Pump @ \$29.95 each. Specify 12 volt or 110 volt.

☐ Check or Money Order enclosed

☐ Charge my Credit Card Account:

☐ American Express ☐ Master Charge ☐ Visa

☐ Diners Club ☐ Carte Blanche

Account # _____

Exp. Date _____

Name _____

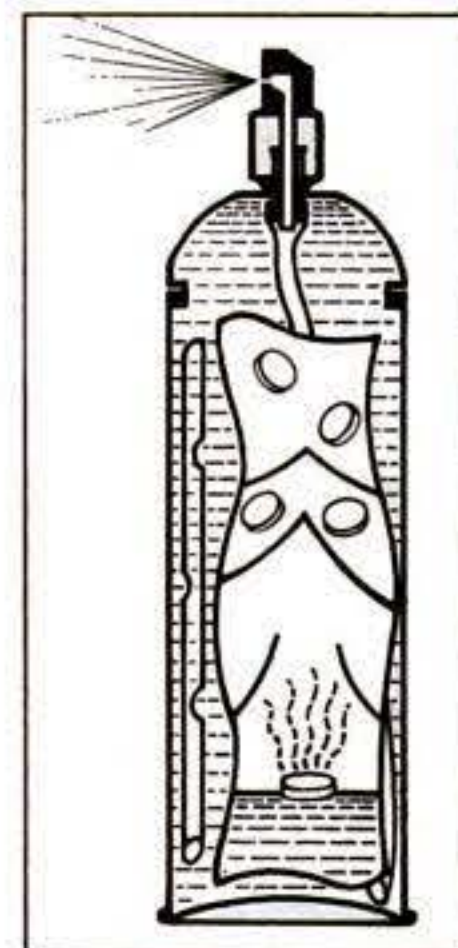
Address _____

City _____ State _____ Zip _____

Signature _____

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**CO₂
spray**
won't hurt
ozone
layer



An ingenious new aerosol may help calm the great ozone debate that has been raging in the U.S. since the early '70's.

The Enviro-Spray, manufactured by Grow Group, Inc., uses carbon dioxide rather than fluorocarbons to disperse the contents of a can. Fluorocarbons were banned in April 1979, after tests showed that they threatened the delicate ozone layer protecting the Earth from damaging ultraviolet rays [PS, June '77].

The new spray, developed by inventor Ellis M. Reyner, consists of a plastic sack, initially pressurized by a small amount of carbon dioxide, then divided into pockets. Each pocket contains a tiny sodium bicarbonate pellet; at the bottom of the sack is citric acid.

When you push the spray button on a can of paint, for example, carbon dioxide expands the sack, forcing paint out of the can. As the sack expands, the heat seals on the pockets break one by one, dropping bicarbonate into the acid and producing more CO₂. The process is similar to one long known to generations of children: mixing vinegar and baking soda to propel a toy boat across the bathtub.

One advantage of Enviro-Spray is that the CO₂ never mixes with the contents of the can, so it can be used with food products—unlike petroleum-based hydrocarbon sprays. In fact, Russell Banks, president of Grow Group, says the new aerosol has been used for everything from beer to caulking.

Another plus: Since carbon dioxide is not flammable, the can won't explode if used close to a heat source, as hydrocarbon sprays may.

When Enviro-Spray goes into production later this year, it will be used only for products manufactured by Grow Group (200 Park Ave., New York, N.Y. 10017). At a later time the company may license and package the system for other manufacturers.—
Harriet Brown

AIR FORCE EXPERIENCE:

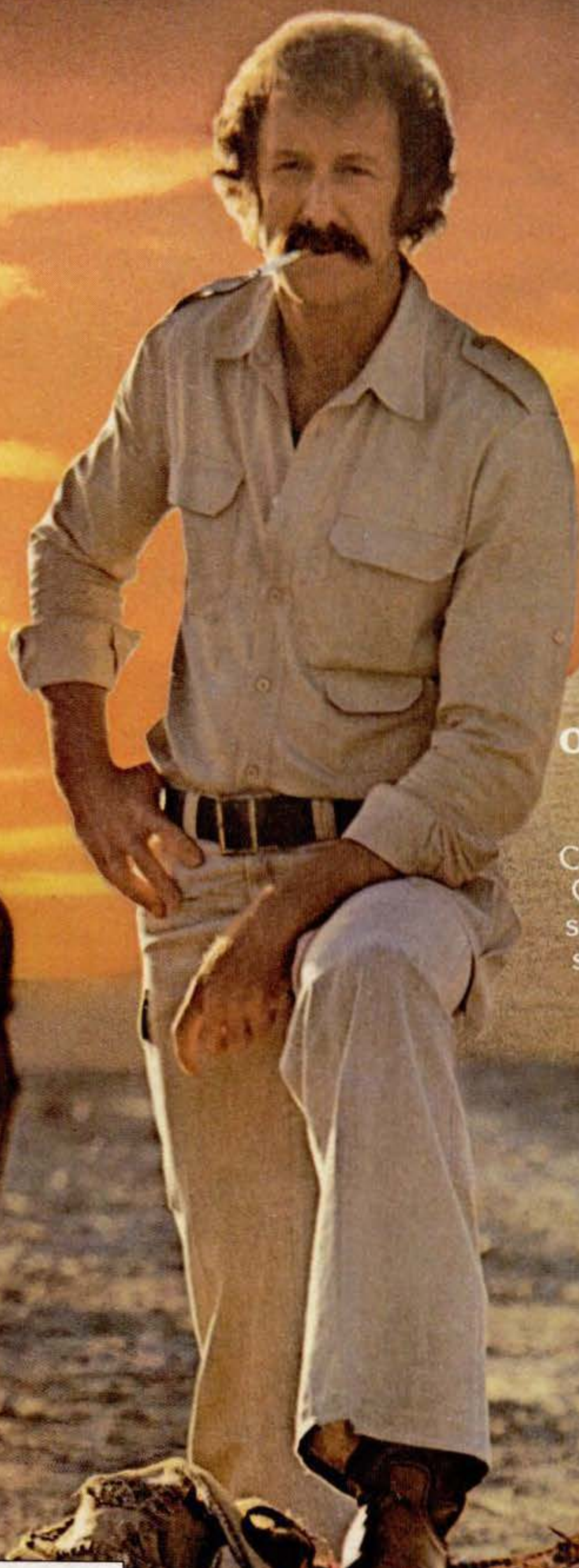
Everybody knows you need experience to get ahead. But AIR FORCE EXPERIENCE can take you as far as you want to go. Great training. Responsibility. Skills you can use for a lifetime. Talk to your Air Force Recruiter about AIR FORCE EXPERIENCE before you make any choice. Do it for your country — and yourself. Call toll free 800-523-5000 (in PA: 800-362-5696), or mail in the card. It can be your ticket to...

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The Camel World of satisfaction comes to low tar smoking.

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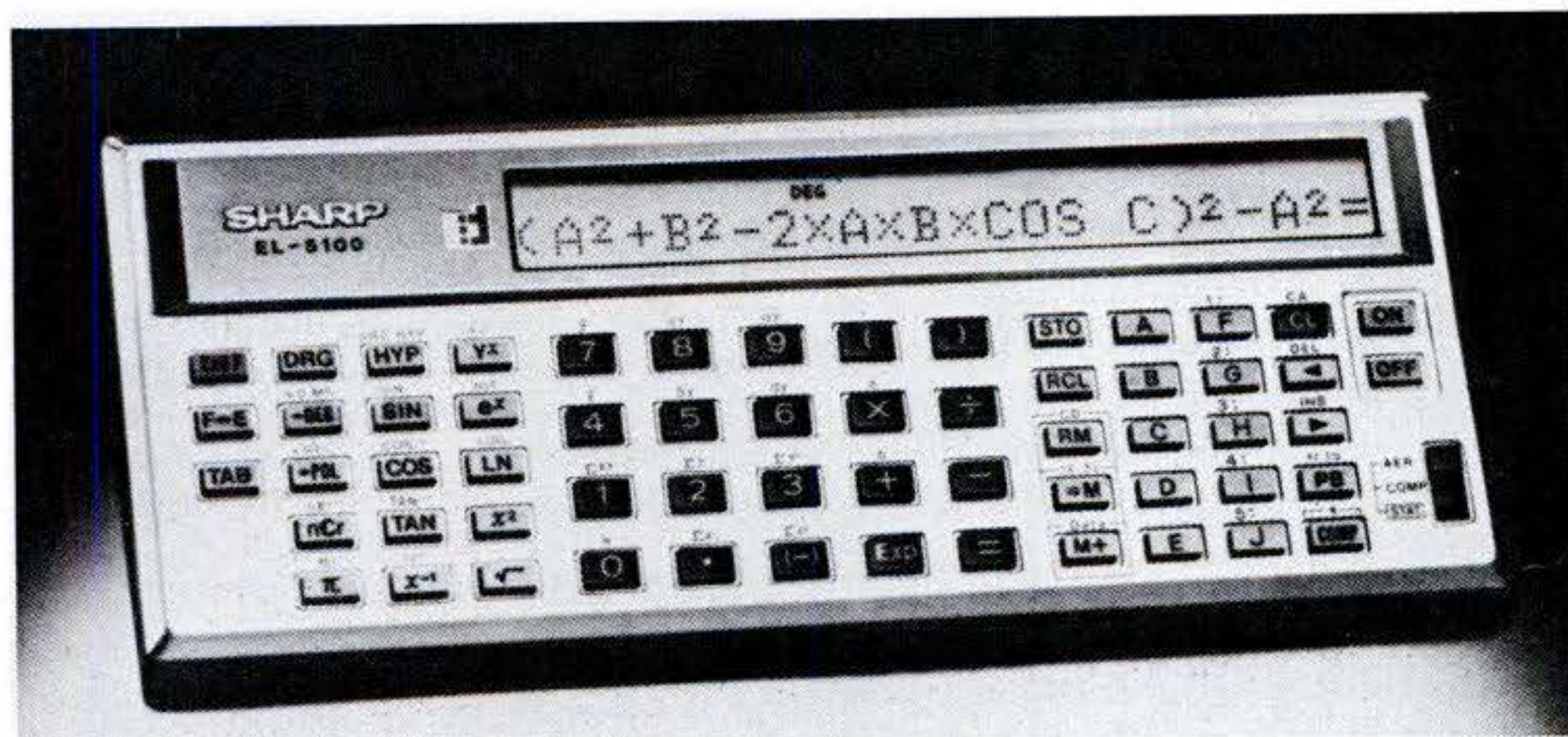


Warning: The Surgeon General Has Determined That Cigarette Smoking Is Dangerous to Your Health.

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CALCU-LETTER

By **DARRELL HUFF** News of pocket calculators—and how to have fun with them



Anyone for programming?

Though they're not billed as programmables, the innovative Sharp EL-5100 (photo) and its companion EL-5101 perform many programming chores—and do them in a way that is especially easy to understand. Your equations can be entered almost exactly in the form you'd write them with pencil and paper. It will be displayed, as you see it here, for examination and correction. Having stored values for A, B, and so on, you get the answer with a touch of the COMP key. You're programming almost without knowing it.

These "algebraic expression reserve" calculators lack some capabilities ordinarily found in programmables. They

can't make tests (such as $x=1?$) or do looping or branching. But they do have a wide range of scientific and statistical functions, and continuous memory, too. Any formulas or values left in memory when you shut off the calculator will still be there when you turn it on again.

The 5100 was introduced to PS readers in a news article in February. The 5101 differs only in having five memories, 40 program steps, and 16-digit display instead of 10, 80, and 24. Its under-\$80 list price is \$20 less than the 5100's.

Inflated yields explained

How some banks can advertise annual yields that seem to defy mathematical

analysis has been explained for our benefit by several score of well-informed readers. A few are bankers, others are math buffs or pros, and still others had been curious enough at some time in the past to confront their banks with the question raised in the January "Calcu-letter." Bill Neef of Grass Lake, Mich., couldn't figure out how 9.524 percent annual interest could turn into 10.138 percent effective annual yield. Figured by standard formulas, it had to come out 9.99, he said.

But federal regulations permit a strange gimmick. Banks may use the traditional 360-day year to figure the periodic rate, then give you 365—this year, 366—days' interest. Instead of raising the useful constant e to (in our January example) the 0.09524 power when compounding continuously, a bank may raise it to 365/360ths of that. Presto! the advertised yield of 10.138 percent.

The practical significance of all this, advises Robert J. Staehling of Woodbine, Md., is that "it pays to shop around—some banks really do pay more."

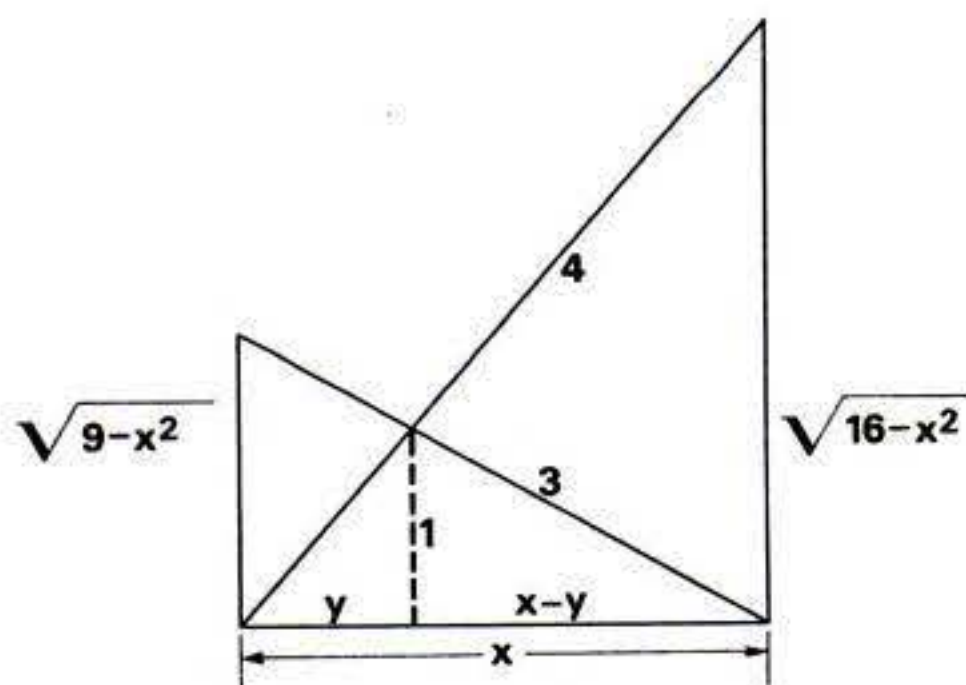
For the asking

The annual edition, just out, of *The Hewlett-Packard Personal Calculator Digest* may help fill a gap for calculator buffs who feel that—this column aside—there's not enough reading material available about their hobby. Along with articles on financial calculators and how chips are made, there's a piece on LC displays, which I suspect are going to replace the glowing kind almost entirely. Their legibility in good light makes up for the fact that you can't see them in the dark, and their low power consumption is an overwhelming advantage. Also featured in this digest, naturally, is the marvelously versatile HP-41C [PS, Feb.], which may be the first really sophisticated unit to go LCD. If you'd like a copy of this publication, send a letter or card to Hewlett-Packard, 1000 N.E. Circle Blvd., Corvallis, Ore. 97330.

Ladder solution

The puzzle in the March column told of two ladders, 40 and 30 feet long, each touching the base of one of two buildings and leaning against the other building. If the ladders cross 10 feet above the ground, how far apart are the buildings?

The reason this stickler is so firmly fixed



in the rolls of cussed puzzles is that it goes back to precalculator days. It can be solved using only basic math, if you use a calculator to extricate yourself from a short but nasty equation.

Using 10 feet as the unit of measurement, and the Pythagorean theorem, you can label your diagram as shown, then set up a pair of equations for corresponding sides of similar triangles. Solving the first for y and substituting in the second gives you an equation with a single unknown:

$$x - \frac{x}{\sqrt{16-x^2}} - \frac{x}{\sqrt{9-x^2}} = 0$$

But here's the catch: It's a quartic equation, having both fourth and third powers of the unknown. That is where your calculator comes in. Its lightning computing ability makes it feasible to find the solution by trial and error, a process that would take many hours if attempted with pencil and paper. You simply make a reasonable guess and substitute it for the unknown. Then another, and another—your result coming closer and closer to zero.

Zeroing in on iterative solutions this way is quicker when you use a programmable model. I used repeated trials of a 27-step program—straightforward but longer than actually necessary—to find the answer (it's 26.03287754 feet) with an HP-19C. Going considerably further, Wal-

ter Lincoff, Carle Place, N.Y., devised a 70-step program for his HP-69 to find the answer in a single run, all the repetitions and tests occurring internally. Dan Laughery, in Baltimore, used 129 steps on his TI-59.

Yes, there are three other roots to the equation: one negative, two complex.

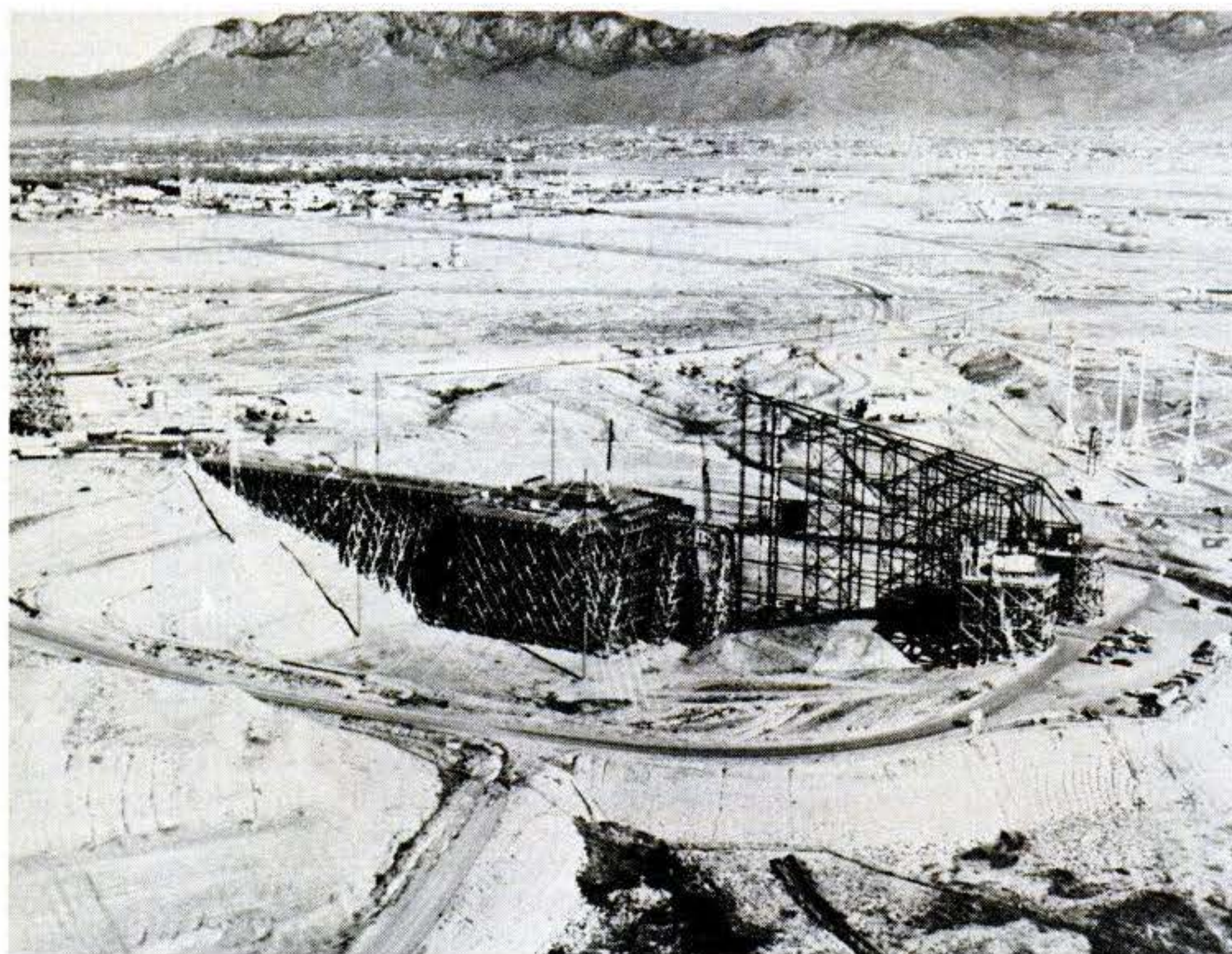
Historical dice

What we now know as probability theory and the art-science of statistics got their great initial boost three centuries ago at the dice table of a French nobleman. The Chevalier de Méré found himself winning consistently when betting even money that he would get a six at least once in four rolls of a single die. In discovering for the knight why this was a winning bet and why others that sounded just as good were losers, the philosopher Blaise Pascal laid the basis for a whole branch of mathematics.

So here's one for your brain and your calculator: Over the long run, what percentage of his bets should the Chevalier de Méré have won? P3

SCIENCE NEWSFRONT

By ARTHUR FISHER



Bomb-blast simulator

Building a structure this big (see the autos for scale) out of wood is usually an engineering exercise left to roller-coaster designers. But this one uses wood because it must. Called the Trestle Electromagnetic Pulse (EMP) Simulator, it will be used as a test stand to check the performance of military hardware aboard aircraft in the very intense electromagnetic fields generated during a nuclear-weapons explosion. Conditions during flight must be duplicated as nearly as possible, so the aircraft must be held off the ground by a supporting structure, which in turn must be non-magnetic and a nonconductor of electricity. Wood was the material chosen, on the basis of its physical properties.

During each test, two five-megavolt pulse generators will be triggered at the base of a large, wedge-shaped structure at one end of the trestle. The wedge acts as a waveguide to channel the electromagnetic fields generated toward a focus at the test deck, where the aircraft sits. The two pulses meet at the apex of the wedge to form a single 10-MV wave that completely envelops the craft. Fence-like antennas on both sides of the trestle will help confine the fields to the test area.

The new complex is located on the grounds of Kirtland Air Force Base, in Albuquerque, N.M. It is a cooperative venture involving the Air Force Weapons Laboratory, Air Force Systems Command, Dynallectron, Inc., and the EG&G Wash-

ington Analytic Services Center, which will manage the facility's operations and maintenance for two years. Data garnered from the tests will eventually be used to design protective shielding for military aircraft.

Rye whiskey, rye whiskey . . .

Watch out for exploding whiskey barrels. That's the word from the Jan. 25 issue of the *Journal of the American Medical Assn.* which reports scattered incidents of injuries suffered by curious children who lit matches to explore the empty whiskey barrels' interiors. Apparently, the containers are becoming a popular ornament in some parts of the country, and are being sold at roadside stands and lumberyards. But the fumes lingering inside the barrels may be highly explosive. Caveat drinker.

Gas-turbine car

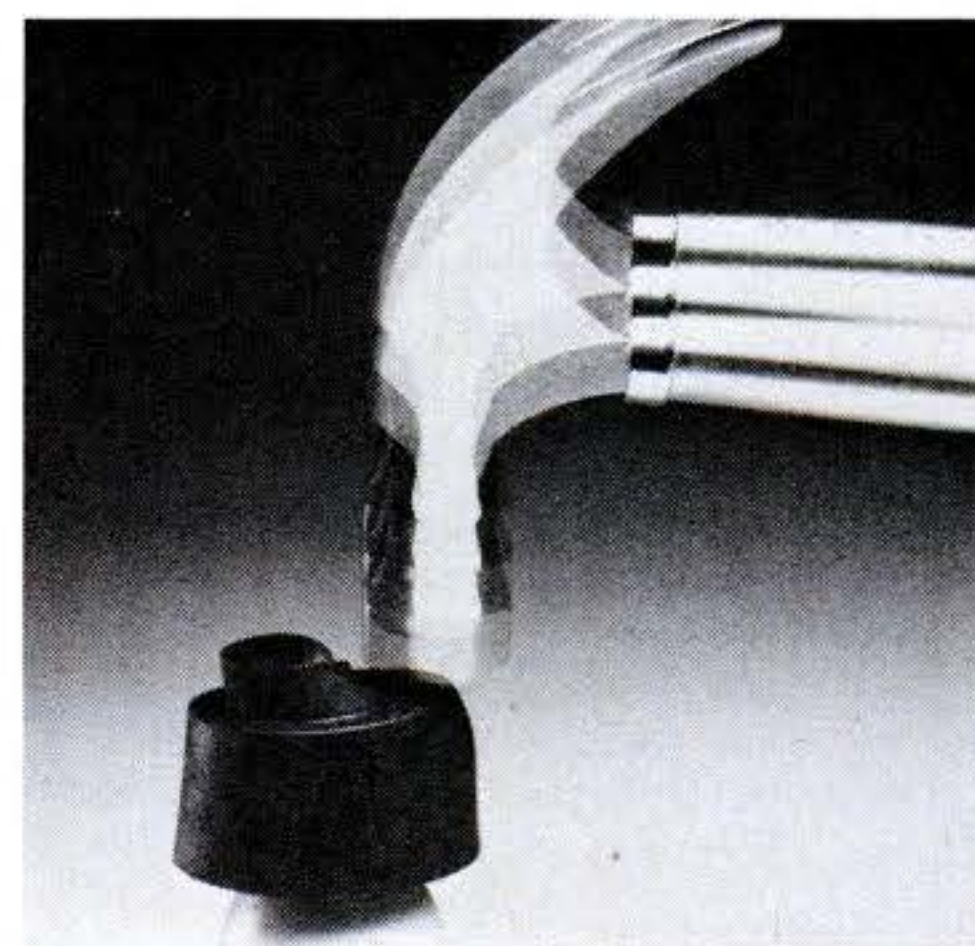
The Department of Energy has dropped the other shoe in its two-part program to develop an advanced gas-turbine engine for autos. Last November it awarded \$56 million to a team including Ford and the AiResearch Manufacturing Co. to produce a single-shaft design. Now it has given \$65 million to a team headed by Detroit Diesel Allison, a subsidiary of GM, for a two-shaft gas-turbine engine with variable geometry. It is to be ready by 1985, and then installed in a front-wheel-drive Pontiac Phoenix with production auto-

matic transmission. It must yield a fuel economy of 42.5 mpg in that 3000-pound car. In addition to fuel saving, the gas-turbine engine promises to be able to use a variety of petroleum and nonpetroleum fuels, and to be relatively nonpolluting.

Super cushion

The strobe photo below of an egg being hammered shows the remarkable cushioning ability of a new plastic material named Sorbothane, a unique quasi-liquid polymer that behaves like a molecular spring: It combines the dimensional stability of a solid with much of the hydraulic behavior of a fluid. Sorbothane was developed by BTR Industries in London, England, and represents a considerable advance in polyurethane elastomer technology. It is made from two liquids—a polyol and an isocyanate—that harden to the finished product when they are mixed and molded. The rate of both distortion and recovery can be adjusted by varying the chemical mix.

Sorbothane can absorb an incredible 95 percent of the energy of a blow and still retain its original molded shape; a remarkable memory capability totally eliminates deformation under normal loads. It conforms to irregular mating surfaces to seal gaps, tends to self-heal when cut, has a wide temperature tolerance, and is safe for prolonged skin contact. This has made it ideal for such applications as heels on running and other shoes, where it reduces injury caused by repeated foot impact; acoustic damping for typewriters, turntables, and tone arms; seals for building components such as skylights; and boat-building. It could have immense value in energy-absorbing auto parts. Cost: about 50 percent more than butyl rubber.



Electricity from infrared

Leo W. Lemley, an electronics engineer at the Naval Research Lab in Washington, D.C., is shown on page 61 with his new invention, an albedo array, which converts the Earth's natural infrared radiation

Continued

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So now you can make money on your *way* to work.

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The low, stepped seat contributes to a more comfortable ride, and allows you to put your feet squarely on the ground when you come to a stop.

Electric starter includes a safety mechanism which prevents the motor from starting unless the bike is in neutral or the clutch is fully depressed.



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LTD Country Squire

Best mileage of any full-size wagon.

Fifty years of Ford wagon technology come together in the 1980 LTD. It's versatile, good-looking and practical with even better mileage than last year—the best of any full-size wagon.

17

EPA
EST.
MPG

24

EST.
HWY.
MPG

For comparison excl. diesels and other Ford Motor Co. wagons. Your actual mileage may differ depending on speed, distance and weather. Actual hwy. mileage will probably be lower than est. Calif. mileage lower.

Unsurpassed room.

No wagon sold in America has more passenger or cargo room than LTD. Based on EPA volume index (112 cu. ft. passenger, 53 cu. ft. cargo). And LTD Wagons are rated to tow up to 6,000 lbs. with an optional towing package.

See your Ford Dealer and ask about the Extended Service Plan.



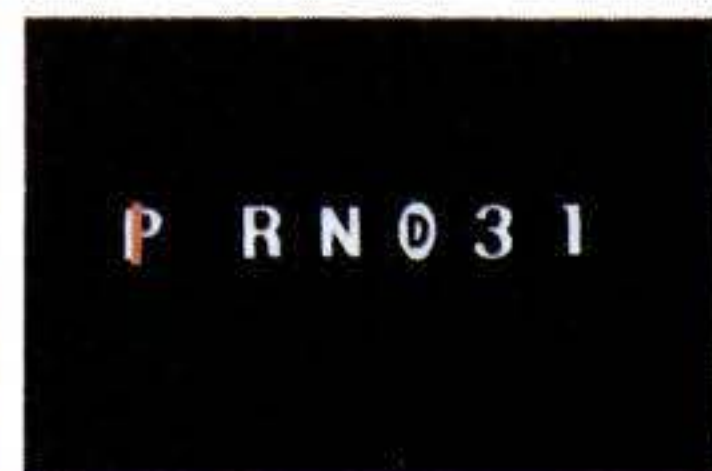
Better Ideas for
the 80's. FORD.

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340-Mile Est. Range; 480-Mile Est. Highway Range. Based on LTD's 20-gallon gas tank and EPA mileage estimates. Your range may differ. Actual highway and California range will probably be lower.



Automatic Overdrive Option. First fully automatic transmission with the benefit of overdrive on an American-built car.



LTD Luxury. Optional Interior Luxury Group shown with rich velour cloth, available in super-soft vinyl or optional leather.



Cargo Room. With the tailgate down, you can actually slide in a 4' x 8' sheet of plywood . . . flat.



3-Way Tailgate. Dual Facing Rear Seats. Tailgate swings open like a door or down like a platform. Dual facing rear seats, an exclusive Ford Motor Co. option, provides seating for two or an extra 7.7 cu. ft. of under-floor stowage (with seat cushions removed).

[Continued]



to direct-current electricity. When electromagnetic energy in sunlight falls on Earth's surface, part of it is converted to heat energy. The warm surface, in turn, reradiates part of this energy back into space in the form of infrared radiation. The albedo array uses energy collectors to turn the infrared energy into heat, and thermoelectric elements to convert the heat into electricity. The current generated would be used for propulsion or to operate sensors aboard high-altitude platforms.

Two solar advances

The pair of pictures below represents two important advances along two very different paths to harnessing the sun's energy.

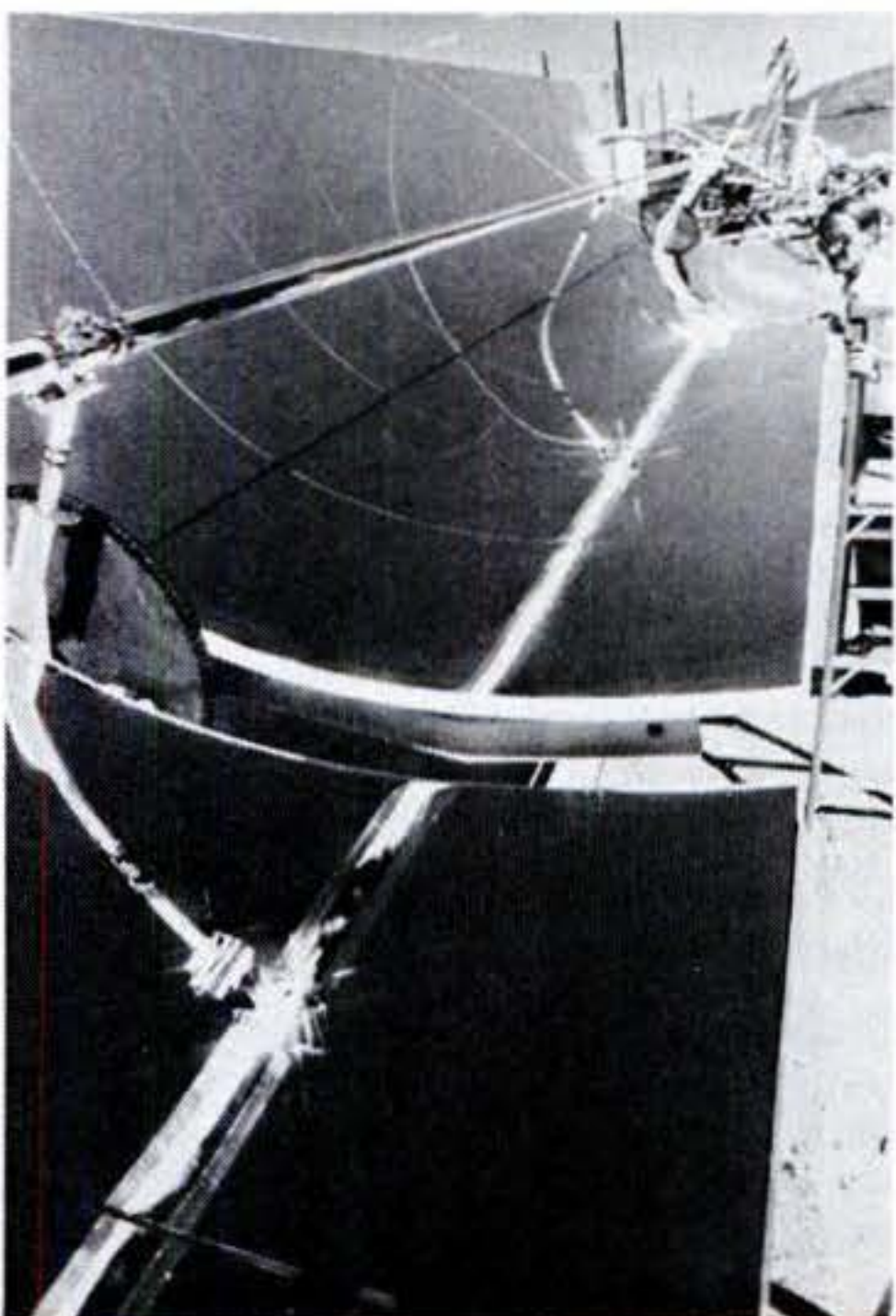
At left is the Engineering Prototype Trough, a parabolic concentrating solar collector developed at Sandia Laboratories in Albuquerque, N.M. It constitutes one phase of a Department of Energy program to improve the performance and working life of the line-focus concentrator. Line-focus collectors have a linear, often trough-like reflecting surface that

concentrates sunlight along a line (rather than at a point, as with some other concentrator designs). The focused light strikes a long, thin, specially coated receiver tube that runs the length of the trough, and contains a fluid, usually oil. The Sandia design has boosted the efficiency of converting solar energy to heat from the 40 or 50 percent with previous line-focus collectors to about 60 percent; the heat-transfer oil reaches 600 deg. F. The improvement results from combining several innovations, including a new black chrome coating for the receiver tube, a silvered, chemically strengthened glass for the reflecting surface, and a microprocessor-controlled tracking system.

In the right-hand photo is a scientist you have seen in our pages before. In "Splitting Water with Sunlight" [PS, June '78], I reported that Prof. Harry Gray, chairman of Caltech's Division of Chemistry and Chemical Engineering, and his colleagues, had designed a remarkable new chemical compound, with two rhodium atoms at the hub of a windmill-like structure composed of carbon, hydrogen, and nitrogen atoms. When the compound in water solution was exposed to sunlight, it transformed solar energy into chemical energy that split water molecules and released hydrogen gas—one of the most desirable of all fuels. One of the handicaps of the process, however, was its very low efficiency—about four percent. Recently, Dr. Gray announced at a meeting of the American Assn. for the Advancement of Science that further experiments show the possibility of using the "solar catalyst" to yield hydrogen with an efficiency of 90 percent.

"If we do achieve an efficiency of 90 percent in hydrogen production," says Dr. Gray, "the impact could be much broader. We very probably could extend this new solar chemistry to other important systems, such as the production of methanol and related fuels from carbon monoxide, and of ammonia for fertilizers from nitrogen."

PS



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wagon
and the
option that
could pay
for itself.**

**The
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long-term
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**Just ask your
Ford Dealer.**

When you order your new Ford LTD wagon, be sure to consider the one option that could pay for itself. Ford Motor Company's Extended Service Plan. It's available to help protect you against rising service costs. And it's backed by Ford Motor Company and honored by participating Ford Dealers nationwide.

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**The option that
could pay for itself.**



**EXTENDED
SERVICE
PLAN**

DETROIT REPORT

By JIM DUNNE

Gas-turbine development

Government money will back gas-turbine development by Chrysler, General Motors, and joint work by Garrett and Ford, as part of an attempt to get turbine engines into production. The latest goals include an engine small enough to fit in a subcompact, plus an even simpler design. The latter will put heavy emphasis on transmission development, to reduce the turbine's 55,000–100,000-rpm shaft speed to usable levels of less than 5000 rpm. In the Garrett-Ford contract, the turbine work will go to Garrett because of their long experience with high-speed turbochargers and jet engines, while the transmission problems will be assigned to Ford. The low-emissions and multi-fuel capabilities of turbines make them more attractive than ever.

Chrysler's diesels

Chrysler's famous 225-cu.-in. Slant Six engine has been adapted for diesel operation, and will be in production just as soon as tooling can be installed (probably by summer 1981). Chrysler also confirms that it will build a four-cylinder diesel from the same basic powerplant, and that it will be ready for production a year later than the six. Of the two, the four-cylinder will play a bigger part in Chrysler's plans, since it alone will fit in the front-drive layout of the company's cars of the future. The six will be shifted to van and light-truck installations when Chrysler's big cars are converted to front drive. The firm plans to build both models with a turbo-charger option. The added power of the turbo will make the 225-cu.-in. diesel an adequate performer in the bigger Chrysler cars and trucks, while the boosted 150-cu.-in. four will perform adequately in intermediate and compact models.

Ford's small diesel

Ford's contract with Cummins Engine Co. to design a big diesel engine was terminated late last year. Instead, Ford will convert its English 1.6-liter four-cylinder engine to diesel power for the Escort/Lynx and other small, U.S.-built products. Ford is confident that their bigger engines can be successfully converted to the PROCO stratified-charge technique, while the smaller engines will be more suitable to diesel conversion.

GM's small diesel

General Motors will offer a high-mileage diesel option on their 1981½ J-body replacements for Monza and Sunbird. (The

J-cars will be the first front-drive GM sporty cars.) The 1.8-liter four will be built by GM's Japanese affiliate, Isuzu, and should deliver highway fuel economy in the high 50-mpg range. Insiders see this as the first serious move against the Volkswagen Rabbit diesel, which currently holds the position of EPA economy champion.

More throttle-body injection

There's a trend toward throttle-body fuel injection in Detroit these days. It's the fuel-injection system that uses a carburetor-like central mixer for the air and fuel instead of individual injectors in each intake port. It's cheaper, gives the air and fuel more time to mix, improves engine smoothness, and cuts emissions. Throttle-body designs are now available on certain Lincolns and Cadillacs, and are expected to replace all other types in future GM and Ford products as soon as the changeover can be made.

GM's front-drive intermediates

General Motors plans to build its intermediate-size cars (Malibu, LeMans, Century, and Cutlass) with front-wheel drive in the 1982 model year, using many of the parts developed for the X-bodies. Engines, transmissions, and suspensions will be highly interchangeable with the compacts, cutting development time and costs. Current models are built with V8 and V6 engines, rear drive, and frame-and-body construction. The new cars will have unit bodies, and will make use of four-cylinder and V6 engines exclusively. Cuts in weight and exterior size will increase fuel economy, but passenger room and luggage space will remain the same.

Future Fords

Stung by criticism that the company's plans for the 1980's were confused, Ford executives decided that front drive is the ultimate concept. As a result of that decision, the company will change all future designs to front drive. The most important change will be to the 1985½ Ford LTD/Mercury Marquis. Slated for a new rear-drive body as late as last December, they will, instead, become smaller, front-drive designs. Engines will be V6's exclusively, with three versions possible: gasoline, PROCO, and diesel. After the big-car change, Lincolns and Thunderbirds will undergo similar treatment.

The next Ford design change you'll see, though, will be to the 1981 Granada/Monarch sisters, which will get versions of the Fairmont/Zephyr chassis. While the un-

derstructure and drive train will be taken from Fairmont/Zephyr, the sheet metal, grilles, and interior and exterior trim will be different. Ford will sell these models as medium-to-high-level sedans, able to compete against the top GM intermediates like Malibu Classic and Cutlass Supreme. Three body styles will be offered: two- and four-door sedans and a four-door station wagon. Styling highlights will include dual rectangular headlights set side by side, and grilles similar to those on the present models. Ford and Lincoln-Mercury dealers will sell the new Granada and Monarch in the same showrooms with the nearly identical Fairmont and Zephyr for one year—1981—before the latter are switched to a front-drive layout.

AMC for the '80's

In the fall of 1982, AMC will begin building a new front-drive car based on a Renault design. It will be bigger than LeCar and smaller than the R-18, Renault's present mid-size car, which is due to go on sale here this fall. According to reports, the company will continue to build Spirits, Concordes, and Eagles at the same Kenosha, Wis., plant, but on a separate assembly line.

Chrysler scraps projects

The \$1.3 billion boost Chrysler got from the federal government will not be enough to allow the company to carry out its most ambitious new-product plans. Several product programs have been, or will be, dropped as a result. Candidates for the chopping block include a V6 engine that was proposed to power the full-size cars of the mid-'80's, a new line of full-size front-drive cars, a mini-pickup truck line, and a 1982 specialty-car derivative of the 1981 K-car. In the end, Chrysler will probably delay its expensive front-drive, big-car plans until the company is established as a strong competitor in the small-car market.

Detroit's quality

If they want to match the imports, one thing American car makers must learn is how to build a better car. There is no question that the Japanese and European cars are, for the most part, put together and finished better than cars built here. "We can learn a lot from the Japanese about building better cars," says Paul Tippet, president of American Motors. "There's no reason we can't build cars as well." By contrast, U.S. cars shipped to Japan must get up to \$1500 of extra work to bring them up to Japanese quality standards. One U.S. company actively promoting sales of its small cars in Japan must repaint every car it ships over there.

Ford "shopping" again

Ford's "want list" that's circulated to big suppliers now describes a 19-inch tire that will run at high pressures, have an ultra-low profile, and improve fuel economy. The company is said to be ready to spend big sums of money on research now. [E]

People write to



Have a question about motor oil? Lubricants? Engines? Ask the Pennzoil experts...

Knock It Off. My '68 car, which runs on regular gasoline, has been having a terrible problem lately with engine knock. Is there any way to combat this knock without switching to premium gasoline? My mechanic cannot seem to solve this problem.

J.H., Canton, Texas

Reducing engine knock or ping in a 1968 automobile should simply require retarding the timing 2 or 3 degrees. However, if your mechanic has found this to be impossible to do without causing a loss of power, then the problem is most likely a build-up of carbon in the combustion chamber. If an engine designed to run on regular gasoline cannot be regulated by ignition timing, one cause may be carbon build-up. One solution is to remove cylinder heads and clean out the carbon. Then the timing can be properly set so that the engine will run smoothly without knocking using regular gasoline. You should definitely take care of this problem in the near future since allowing an engine to knock on a regular basis can result in engine damage.



A Bearing Lesson. Is it harmful to ball and roller bearings if they're first washed with gasoline or light motor oil before wheel bearing grease is applied? What are your recommendations for cleaning wheel bearings?

K.K.T., Rochester, MN

Wheel bearings should be cleaned with a quick drying solvent, available at auto parts stores. Gasoline can be used but we do not recommend it since it contains materials which could be harmful to the bearings. Applying a light motor oil to wheel bearings can also be damaging. Use a medium bristle brush to wash the bearings and inspect for nicks, scratches, wear and heat discoloration. The bearings should then be dried with low pressure compressed air,

but be sure to avoid spinning. Brush out the dust and dirt from the brake drum, and wipe the old grease from the bearing races and spindle. Then apply a thin coat of grease to the hub, spindle and races. When repacking the bearings by hand, be sure that the grease is thoroughly worked into the cages and rollers.



The Time Has Come. I have 2 cars, a '58 Cadillac and a '69 Ford, which I drive very infrequently. A little over 13 months ago, I put Pennzoil P-Z-L in both cars' engines and have driven each car less than 3,000 miles since then. Most of the driving has been around town—at about 40 mph. The oil in both cars still looks clean. However, since it has been over a year since the last oil changes, do you suggest I change the oil? Would you recommend I stay with P-Z-L or switch to regular Pennzoil?

M.S.T., San Diego, CA

With very short driving conditions and low mileage over a 13-month period, moisture condensation has most likely built up in the crankcase oil of both of your cars' engines even though your oil may look clean. An excessive amount of moisture reacts with the oil's additives and could cause corrosion of vital engine parts. We recommend that the oil be changed and suggest that you continue to use P-Z-L for maximum engine protection.

Fit As A Filter. I'm confused about the size of oil filters required for my 2 cars. The oil filter for my 4-cylinder, 89 cubic inch VW is 1¼ inches smaller than the filter used in my GM V-8 350 cubic inch engine. Why does an engine almost 4 times as large as the other call for a smaller filter?

W.F.S., Oak Lawn, IL

The diameter or height of an oil filter

has little to do with its filtering capacity. It is the internal construction and square inches of filtering surface that the media provides which determines the efficiency of an oil filter. Always follow the manufacturer's recommendations and never install a filter unless it is warranted to exceed the original equipment specifications.

Hard Times. I've been having a difficult time starting my '67 van in the mornings. I usually have to pump the accelerator pedal 15 to 20 times before the engine starts up. Is there anything I can do to correct this situation?

D.A.C., Central Falls, RI

Hard starting can be attributed to a number of factors. The following is a list of things that should be checked: distributor caps, points, plugs, condenser, automatic choke, plug wires, fuel and air filters, vacuum leak and carburetor. We suggest that on a cold morning you have someone check the choke when you are about to start the engine. When you depress the accelerator in the early morning the choke should come to a nearly closed position. If it is tightly closed you may get over-fueling which results in hard starting. In this case, a choke adjustment would be recommended.

WE'RE OPEN TO QUESTIONS about motor oils, lubricants, engines. But, you can tell us a few things, too. Maybe you have discovered something interesting about motor oils or lubricants. Or you have a special reason for being a Pennzoil fan. We would like to hear from you. Write to: Pennzoil Company, Research Department, P. O. Box 808, Oil City, Pennsylvania 16301. Note: sorry no pictures or material can be returned. Letters chosen for publication are subject to revision necessary for publication requirements.

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New generation of **dirt bikes**

By **RAY HILL**

Four-valve combustion chambers, long-travel suspension, air-assisted forks, gas-oil shocks, tires that work well in dirt and on pavement, electronic ignition—these are some of the many changes and refinements in off-road motorcycles.

To check out all this hardware, I rounded up six 1980 dirt bikes and tried them out recently at the Blackwood Moto-Sports Park in Blackwood, N.J. The park consists of miles of trails and a motocross course, allowing me to try the machines over varying terrain.

The test motorcycles were Kawasaki's KDX 175 and KDX 400, Honda's XL 500 and XR 250, and Yamaha's IT 250 and TT 500. These bikes are representative of the state of the art and of the variety available in recreational off-road motorcycling today. Let's take a closer look at them.

KDX 175. New for 1980, this is one of the best Japanese off-road motorcycles ever built. It has a single-shock fulcrum-type rear suspension called Uni-Trak. Unlike a conventional rear suspension, which uses two shocks (see drawings), Uni-Trak's has one large shock mounted low in the frame.

This setup, combined with 9.8 inches of travel front and rear and a dry weight of only 214 pounds, makes this machine a super-handler on bumpy motocross-type terrain or on woods trails.

It has CDI (capacitive discharge ignition). As with cars, this electronic ignition has the advantage of being durable and accurate over a wide rpm range, and the ignition timing doesn't change with age. But it works differ-

Continued



Having fun in the dirt: Cresting a hill are, from left to right, a Honda XR 250 piloted by Honda's Jon Row, a Yamaha IT 250

with PS staffer Ray Hill in the saddle, and a Kawasaki KDX 175 with Kawasaki's Richard Smith aboard.



Long-travel suspension (LTS) is at work in Kawasaki KDX 175, airborne (left) with both wheels fully extended. Upon landing, both wheels compress—in this case,



9.8 inches. Until recently, the norm for suspension travel was half this much. The improvement in rider comfort and control made by LTS is tremendous.

WHY MORE AND MORE PEOPLE WILL BE MOVING UP TO A NEW MIDDLEWEIGHT THEY CAN'T EVEN PRONOUNCE.

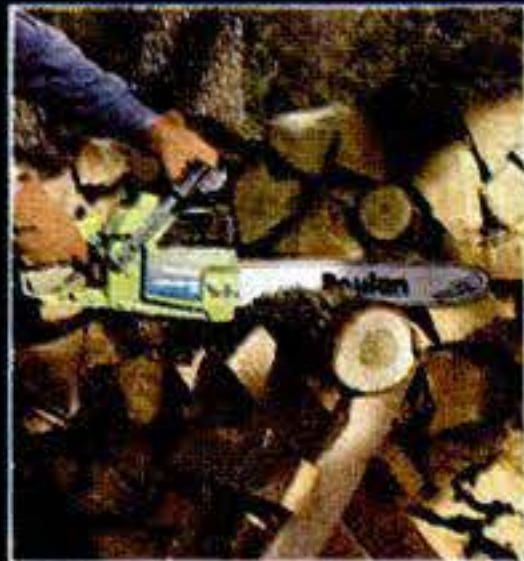
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And the new
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And while it's got everything it
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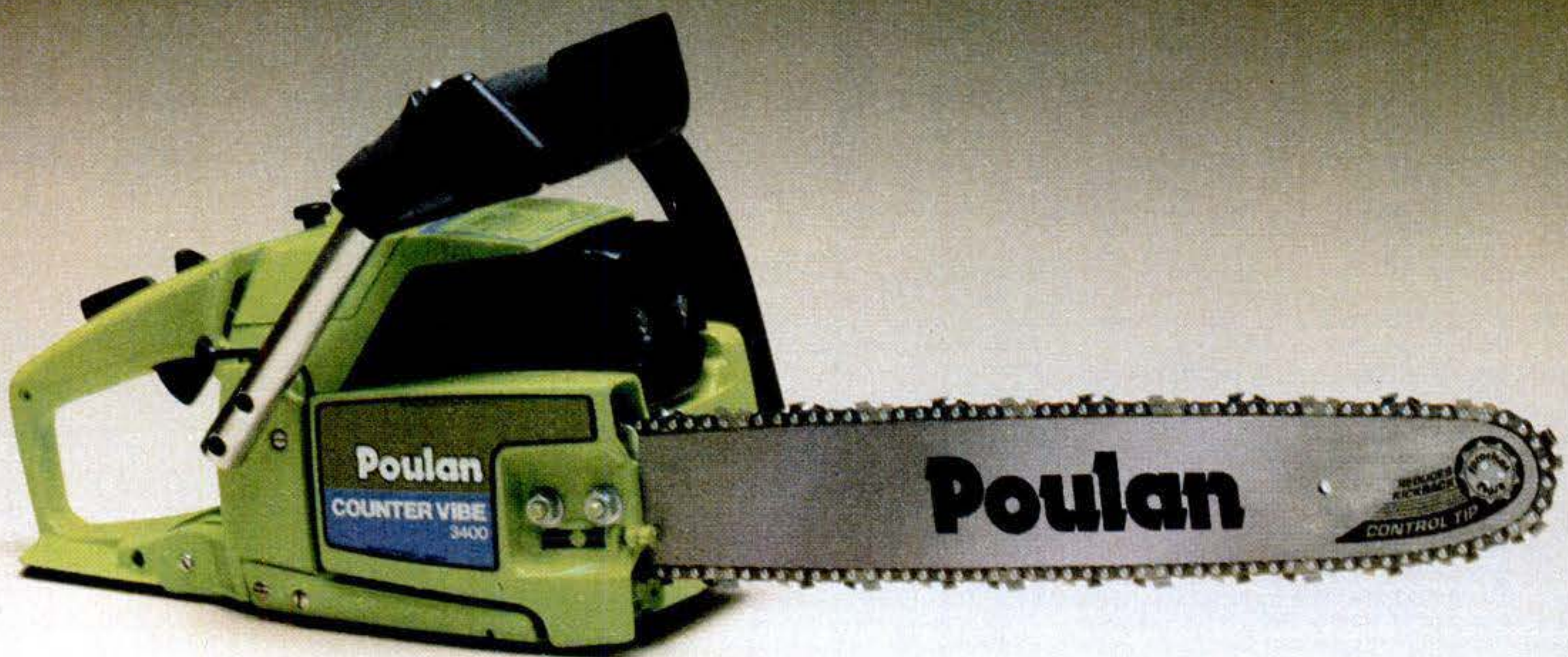
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Canon VS Canon

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company is always a difficult
step — especially when you
are improving your
historically proven best.

Remember the Canon P10-D? It was a major breakthrough in portable high performance, printing calculator technology - two years ago! And, since that time it became the most copied little portable in the industry. But, nothing matched its styling or technology. Nothing, until the all new P5-D.



For openers, the P5-D is smaller yet than the P10-D, if you can believe it. Actually, the new model is a full inch narrower, only 3 1/4" wide. And a quarter inch thinner, approximately 1 1/2" thick. But, its beauty is in its remarkable 17 ounce portability.

Where the old P10-D had a cumbersome paper roll that was propped on a brace making it almost impossible to put into an attache without knocking the paper askew and unravelling the roll, the P5-D is streamlined. Firstly, the entire roll is encased in a closed, see-through plastic compartment. Paper can't unravel and can't get dirty. Secondly, the roll compartment is no higher than the overall housing - itself 1 1/2" thick. It rests flat in the shallowest briefcase. Its overall length - paper roll included - is 8 3/4".

PLAIN PAPER - MIRACLE PRINTING

The printhead of this remarkable unit is a smaller version of the P10-D. It weighs all of 1/4 ounce as compared to traditional printheads which weigh almost two pounds. The system uses plain, 1 1/2" wide paper available almost everywhere. It is almost fascinating to watch the two discs of the printing mechanism instantly spin along their axle at the touch of a button. Traditional print devices with up to 12 separate wheels often suffer from misalignment, overprinting and varying degrees of illegibility. But the P5-D, with its dual disc system, prints up to 10 digits plus codes evenly, instantly and with crystal clarity.

AC OR PORTABLE

Built into the P5-D is a nickel cadmium rechargeable battery pack. You never have to bother with battery replacement. Of course, the unit comes with its own AC power cord. It's a beautiful desk calculator and when plugged in, it

is automatically being recharged. On battery power the Canon will operate for an entire paper-roll's worth of work.

DISPLAY AND/OR PRINT VERSATILITY

Switch the unit to "Print OFF" and the printer operates as any 10-digit display calculator. Large blue fluorescent digits are clearly visible across the 3 1/2" wide window. With the printer working, too, you can check entries before they are actually recorded on tape. And, there's nothing small about the comfortably large buffered keyboard.

SUPER KEYBOARD MEMORY

Our top-flight bookkeeper found it hard to outpace the split-second printer. But, if you can, the keyboard remembers every stroke and zips on at .7 seconds per line. That's fast!

TOTAL OFFICE MACHINE PERFORMANCE

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- Dual - Portable and AC - Power Operation
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- Buffer Memory Keyboard
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Of course, the P5-D handles add-on/discount operations, power and reciprocal calculations, constant factor computation and mixed calculations.

IT'S DIFFERENT FROM THE P10-D

In addition to being newer, smaller, lighter and more streamlined, the P5-D is easier than ever to use. Since most people hardly use more than the Floating Decimal setting (decimal pops into place automatically) and the Add Mode (fixed 2-place position for rapid currency entry), why add other cost-incurring settings? The P5-D features these two positions and has also eliminated the code and item keys. Result: the keyboard is more spacious and the new unit, despite inflation, is just \$59.95.

IT'S \$30 LESS

The P5-D comes complete with AC adaptor, power cord, built-in rechargeable batteries and 3 rolls of paper. For only \$59.95. But, if you truly need a decimal selector with Floating, 0, 2, 3 and add mode settings, item and code keys, we also offer the original P10-D. It is still \$89.95.

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Frankly, both units are exceptional because both are made by one of the largest and most highly regarded electronic firms in the world. And both are backed by Canon's one year limited warranty. But, in our opinion, the P5-D is your best value.

Please, prove it to yourself for 10 days. Work with the P5-D. Put it in your attache and take it to your next meeting. If, after 10 days, you are not fully satisfied that it is a superior quality unit in every respect, just return it to us for a prompt, no-questions-asked refund.

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Dirt bikes

[Continued]

ently than other electronic ignitions.

With CDI, when it's time for the spark to fire, an electronically triggered capacitor releases a momentary voltage through the ignition coil's primary windings. This induces a high voltage in the coil's secondary windings to fire the plug. CDI is on many Japanese dirt bikes for 1980.

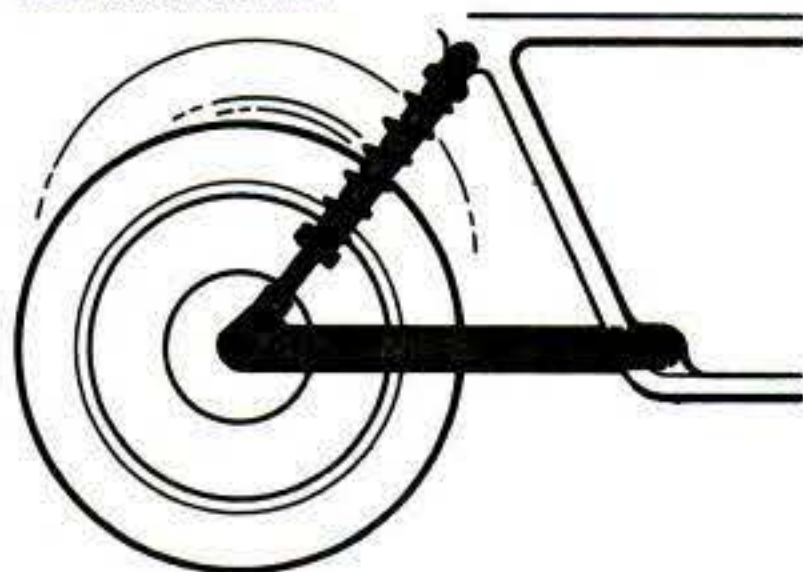
A third interesting feature on the 173-cc two-stroke KDX is a specially coated cylinder. Kawasaki calls the coating process Electrofusion. It consists of stretching nine 1.6-mm carbon-steel wires through the center of the aluminum cylinder and passing 13,000 volts through each wire. Six 1.5-mm molybdenum wires get the same treatment, at 16,000 volts.

This explodes the wires against the

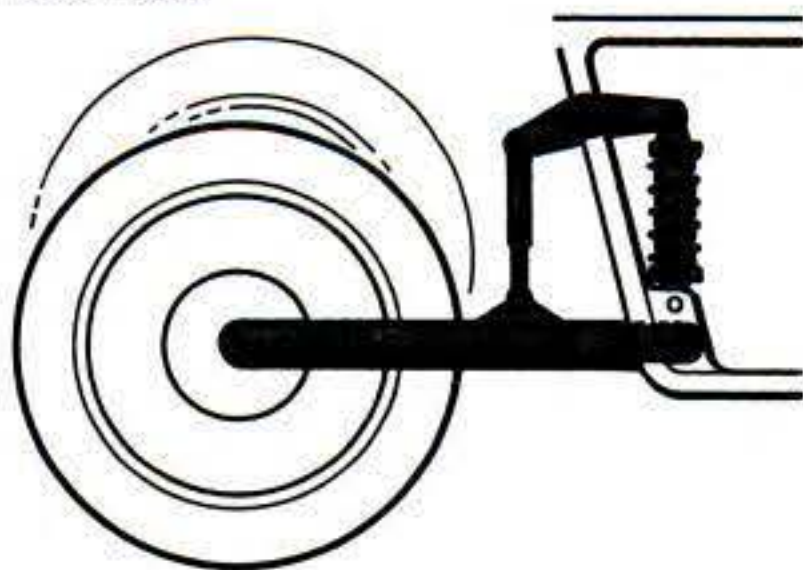
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Rear suspensions

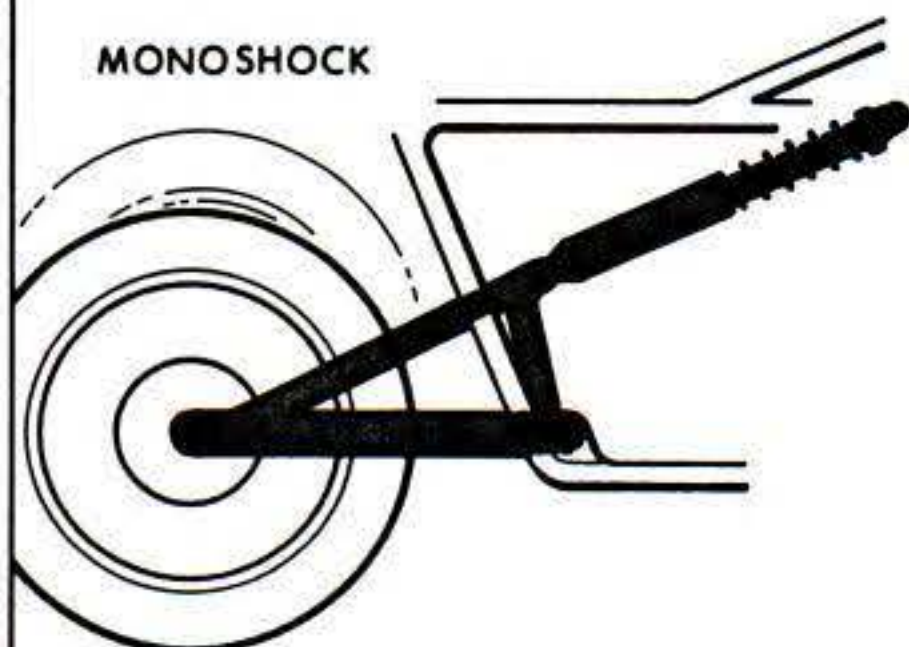
CONVENTIONAL



UNI-TRAK



MONOSHOCK



Conventional rear suspension consists of two shocks. Each is attached to the pivoting swing arm and to the frame. Uni-Trak attaches one end of the shock to the frame and the other end to a pivoting arm which receives swing-arm input. As produced on the KDX 175, this system works very well. Monoshock is under gas tank. Triangulated swing arm flexes less, handles better.

THE TIGER THAT STANDS STILL WHEN YOU LET GO.

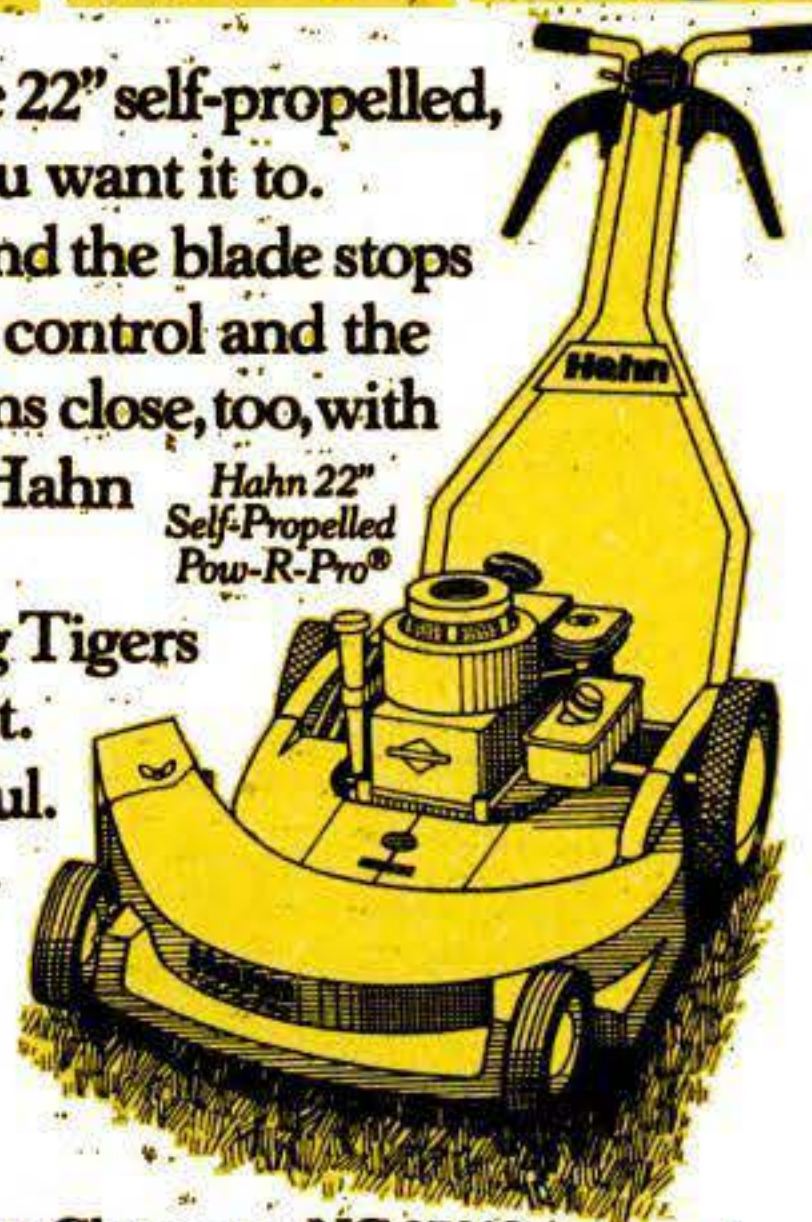
Hahn designed this maneuverable 22" self-propelled, dual-control mower to stop when you want it to.

Release the BladeMaster control and the blade stops in seconds. Release the DriveMaster control and the wheel drive disengages. This Tiger trims close, too, with a low profile front and the exclusive Hahn trimmer notch on the left side.

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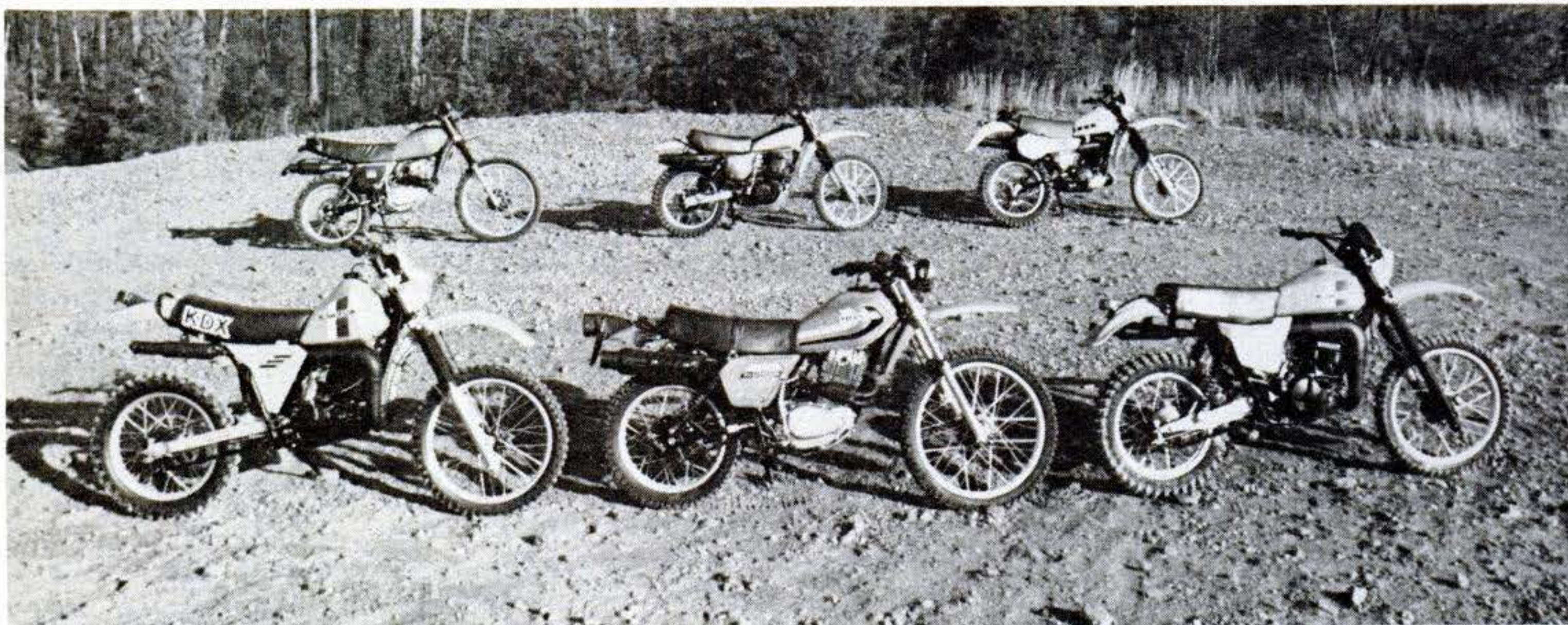
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Dirt bikes

[Continued]



Bikes PS tried: front, l. to r., Kawasaki KDX 175, \$1339; Honda XL 500, \$1875; Kawasaki KDX 400, \$1899; back, l. to r., Honda XR 250, \$1548; Yamaha TT 500, \$1849; Yamaha IT 250, \$1798.

Little folk can have fun in the dirt, too. This is Suzuki's JR 50 (\$419), designed for youngsters. Our test rider is five-year-old A. J. Frank, who has been riding for two years. He's the son of Western-Eastern Road Racing director Dr. Peter Frank.

cylinder, coating it with a thin, hard layer. Kawasaki says that compared with a conventional cast-iron cylinder sleeve, the coating provides better heat transfer, longer wear, more resistance to seizure, and better lubrication (because it's more porous and holds oil better).

The Electrofusion cylinder can take slight honing. But once it's worn out, it can't be bored to the next oversize as a conventional cylinder can.

KDX 400. Suspension travel on this bike is 10.2 inches up front and 9.1 inches in back. That absorbs a lot of bumps. The engine also has the Electrofusion cylinder.

Although it handles adequately, it cannot best the KDX 175 in a handling duel. Its primary attraction is a 392-cc reed-valve two-stroke engine—so powerful that fourth-gear wheelies are easy for an experienced rider. It's also so explosive that an insensitive twist of the throttle in the lower gears can flip the machine over backward.

Both KDX's are typical of the off-road-only type of machines from Jap-

anese makers. They can be licensed for the street in most areas, but are designed to be ridden in the woods, either in enduros or as play bikes.

Honda XL 500. This is a dual-purpose machine, for off-road and street use. There are two nice things about it—the tires and the engine.

Multi-purpose traction

In the past, tires on dual-purpose bikes did not work well. In the woods their block-type pattern could quickly fill with mud, making traction something you only wished for. And they were skittish when cornering on pavement. The ideal is an impossibility—a knobby tire that can change into a street tire upon demand.

Honda did the next best thing. It made a knobby tire with a rounded profile. If you looked at a cross section of the tire, you would see a smooth curve from sidewall to sidewall.

I rode an XL 500 for 600 miles on both street and dirt, on rain-soaked pavement, muddy trails, dry trails, dry pavement, and once for 50 miles on a snow-covered trail. The tires

worked splendidly. You can ride this bike to work, and you can ride it in the woods on weekends.

Turn signals are mounted at the end of rubber stalks. In a fall, they bend, decreasing the likelihood of a turn signal breaking. They seem to work well. On one trail ride, a friend of mine dropped the bike a few times, but the turn signals came out unscathed.

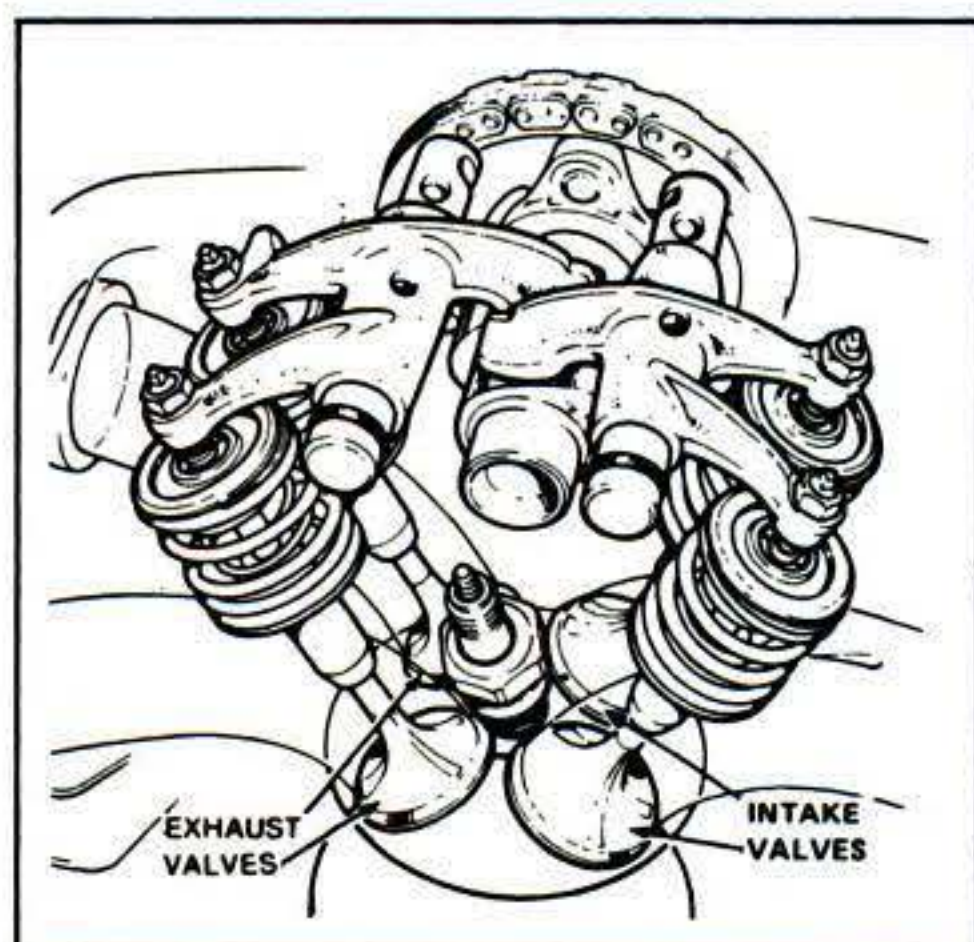
The single-cylinder 497-cc overhead-cam engine has four valves, two intake and two exhaust (see drawing). This allows quicker, higher revving for better performance, and also provides better intake and exhaust flow than standard two-valve combustion chambers.

Vibration can be a problem with big singles. Honda solves this problem nicely with a pair of chain-driven counterbalancers by the crankshaft.

Starting a big single can be a hassle, too. Honda makes the process easy by fitting a compression release that is automatically actuated by the kick starter.

Honda XR 250. This is a single-cylinder 249-cc bike designed for off-road use only. Its engine is like the XL 500's, but smaller. The 250 version is a gutsy little machine, fun to ride, with enough power to climb any hill you encounter, as well as do a little wheelie-popping along the way. It's not in the league with the two-stroke Kawasaki KDX, Suzuki PE, and Yamaha IT series off-road bikes, but it's not meant to be. It's a fun off-road bike that offers the kind of tractable power that only a four-stroke engine can give you.

Yamaha IT 250. A single nitrogen/oil shock-spring combination under the gas tank takes care of the rear suspension. Called Monoshock, the sus-



Honda four-valve head has spark plug centrally located. During start-up, compression release automatically opens exhaust valves slightly at TDC.

pension system permits the use of a triangulated swing arm (see drawings). More rigid than a conventional swing arm, it contributes to better handling.

Spring preload, damping rates, and nitrogen pressure are all adjustable (the owner can adjust spring and damping; nitrogen should be adjusted by the dealer). The nitrogen pushes against a free-floating piston inside the shock. Besides providing damping assistance, the nitrogen keeps the piston pressing against the shock oil, preventing aeration of the oil and loss of damping during long periods of hard riding.

Air-assisted forks let you add air to the forks to prevent bottoming of the front wheel in rugged riding conditions. The forks still use springs and oil inside, so even with no air you have springing and damping action. This feature is also on the KDX 400, and on several other Japanese dirt bikes.

The 246-cc two-stroke is surprisingly powerful and a real pleasure to ride. CDI ignition keeps the spark plug sparking.

Yamaha TT 500. This is a play bike. It's heavy. This, combined with meager suspension, discourages you from trying to go fast over bumpy terrain. But the motor is so controllably powerful that these shortcomings are overlooked by thousands of satisfied owners. And the engine is reliable and versatile. I've seen these things used for everything from road racing to enduros.

This by no means covers the entire model lineup of the four major Japanese makers. But it gives you an idea of the variety available, and the increasing sophistication of the hardware. Whether you're a raw beginner

or an expert, there's a dirt bike with a personality to suit you.

And the quality of the equipment today, compared with that of a few years ago, has come a long way forward. Consider, for example, Honda's first dirt bike, the CL-72. That was a 250 "scrambler" introduced about 20 years ago. Its front suspension travel was 3.14 inches. Rear travel was 2.67 inches. And dry weight was a whopping 337 lbs. Other makers produced dirt bikes that were of similar weights

and had limited suspension travel.

Only in the past few years have off-road machines really begun to show substantial improvement in suspension and weight reduction, and in more powerful and reliable engines. Today you can take a serious off-road machine, such as one of the Suzuki PE machines, and ride it right out of the showroom to a 100-mile cross-country enduro. And you know it will finish. And it'll be ready to go again the next day, too. PS

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Whatever your trucking needs are, you can fill them with any one of our Jeep Trucks. In short, Jeep Pickups fill the bill—in terms of size, payload capacity and performance. And, when it comes to style, check out our new Sportside Pickup.

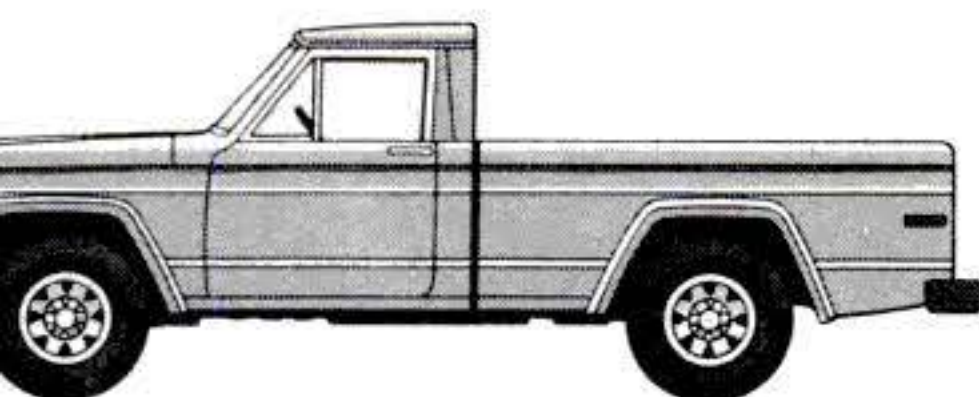
There's a payload capacity that's just right for you. In fact, our standard J-10 Pickup has a greater payload capacity than comparable Ford, Chevy or Dodge pickups.

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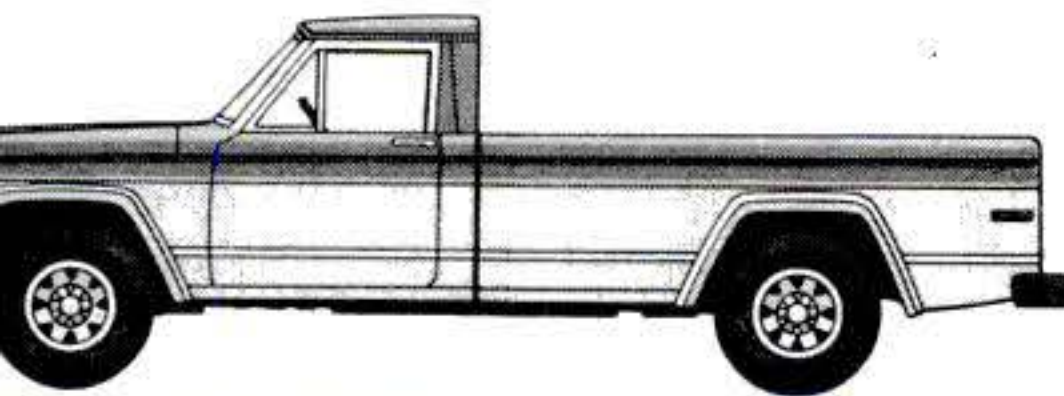
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"SAY, SMOKEY—"

A clinic on cars by Smokey Yunick, America's most famous mechanic

A correction

As a longtime PS subscriber and avid reader of your column, both from a technical as well as a professional standpoint, I read with interest the "Too much shimmy" letter in your Oct. '79 column.

In 1974, the problem was first identified on Ford low-GVW F100 units, usually with manual steering, and after extensive investigation, a technical service bulletin was issued to the dealership service departments. Replacement of the radius arm insulators with new insulators molded from a "high damp" rubber compound was found to resolve the described condition.

A copy of the service bulletin is being forwarded to Mr. Payne in Catoosa, Okla. Perhaps in the future we can be of help on other Ford truck suspension concerns.

Richard E. Collett
Suspension Design Section, T.R.P.O.
Ford Motor Co., Dearborn Mich.

Thank you. And you get a gold star for being the first active manufacturer's representative to offer precise corrective advice on a problem raised in this column.

Rear-wheel hop

I have a '77 Chevy heavy-duty ½-ton pickup with three-speed stick, six cylinders, eight-ft. box, and limited-slip differential. It is used primarily for transportation on snow-covered roads, not as a hauler.

When it loses traction, the rear end "hops" bad enough that the shift lever threatens to jump off its column. I have to shove in the clutch and get a fresh start, and do this repeatedly until I get in different traction conditions. It hops with tire chains on or just snow tires. I normally carry about 500 lbs. of weight in the rear.

I don't think it's the differential. It acts more like spring wrap-up. Could the rear springs be too stiff? Is there a cure?

Keith J. Massart, Algoma, Wis.

Axle wrap-up is the problem. Lighter springs and spring clips can help. Traction bars sold in off-road shops would be a big help. But the most effective solution is to get a deal going at each wheel where you've got one shock about six inches in front of the axle, and another shock about six inches behind the axle.

Needs different gearing

I don't take my '76 Bronco with its 302 V8 and automatic transmission up hills or out in the boonies. It's simply my insurance policy to see that I get to work on each winter's day.

I pay the premium on the policy every time I pull its 4.11 rear end up to the gas pump. I'm willing to lose torque to gain mileage. What action can you recommend?

Guy W. Roark, Waynesville, Mo.

Put the highest gear you can get in it, and tires with the biggest outside diameter. Overdrive would be great, but it would cost too much for a retrofit.

About diesel cars

You've been consistent in your condemnation of the VW diesel Rabbit. Is it worthwhile to sink our hard-earned bucks into diesel Rabbits or is the idea just a flash in the pan?

Brian P. Sullivan
APO, N.Y. (Riyadh, S. Arabia)

The bottom line is that diesel is lousy fuel for cars compared to gas. Diesel has to be hospital-clean when it reaches the injectors. And there's no way in hell that it is. There is no difference in the two fuels in reference to fuel economy—except in Btu content, and diesel is 10 percent better there. So I'm for changing engines to react with gas as well as or better than with diesel, and quit kidding ourselves.

We can and will double gas mileage, and it will happen sooner than you think. The gasoline engine can and will be made to burn any damn thing you put in it. The thermal efficiency will be equal. And when that happens diesel will cost 10 percent more than gas. And even with a multi-fuel engine you'll use gas.

Low oil pressure

I brought my '68 Pontiac Bonneville to the shop to be repaired. The mechanic determined the problem to be a collapsed hydraulic lifter. He advised me that when this is replaced all the other lifters should also be replaced.

Upon receiving the car from the shop, I noticed that the reconditioned engine was much quieter. However, there seems to be a discrepancy in the "new" oil-pressure reading. Before the lifter collapsed, I was getting 30–40 psi, which is what the service manual calls for. Now 20 psi is the maximum reading. At idle, it drops to about six psi.

What's wrong?

J. M. Paluch, Springfield, N.J.

It's possible you got the wrong lifters. The location and size of the groove around the lifter can offset oil pressure. Since about all GM lifters are the same size and look

Continued

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"Say Smokey—"

[Continued]

very much alike, it's pretty easy to get the wrong ones. You could help upper-rpm oil pressure with a stronger spring relief-valve in the oil pump, but this won't help at idle. There's an outside chance that the oil-pump pickup screen is plugged, and it's a coincidence that this showed up after you got the lifter job.

Overheating

I bought a new 530i BMW in July '75. I had to add a quart of coolant each week while many mechanics searched for the leak. Present mileage is 25,000. They did many expensive replacements, putting in a new water pump (mist escaping) and a cylinder head (fine crack). This was before I noticed the loss of steam and coolant from a 1/2-in. hose in the system. Since then there has been no loss of coolant.

However, immediately after replacing the water pump, the car began overheating. The change was sudden and occurred at once.

Mechanics say that the water pump cannot possibly be the source of the overheating. Their latest suggestion is to replace the radiator core. Because the change was sudden and immediate, and because coolant has always been clean—no rust or anything else—I find it hard to believe that a new or larger core would make any difference. Any ideas?

Aaron Podolnick, M.D., Great Neck, N.Y.

I suspect a bad thermostat and no circulation, or very low circulation. The radiator can be checked for flow at a good radiator shop. It may be plugged. But I'm betting on a circulation problem caused by the fancy plumbing scheme the Germans use to achieve fast warmup and maximum temperature for efficiency and cleaner emissions. Also, much care must be taken when filling to get the air out of the system.

Backfiring

I have a '79 Datsun 510 with 120-c.i.d. four-cylinder engine. It has an air pump and no converter. For the 10,000 miles I have driven the car, it sounds more like it's been fed beans than gasoline. Every time I take my foot off the accelerator during shifting, the engine backfires. It's been to the dealer several times, and has even gotten a new air pump. Any adjustment of the mixture does not seem to help. Any ideas?

William A. Jackle, N. Chatham, Mass.

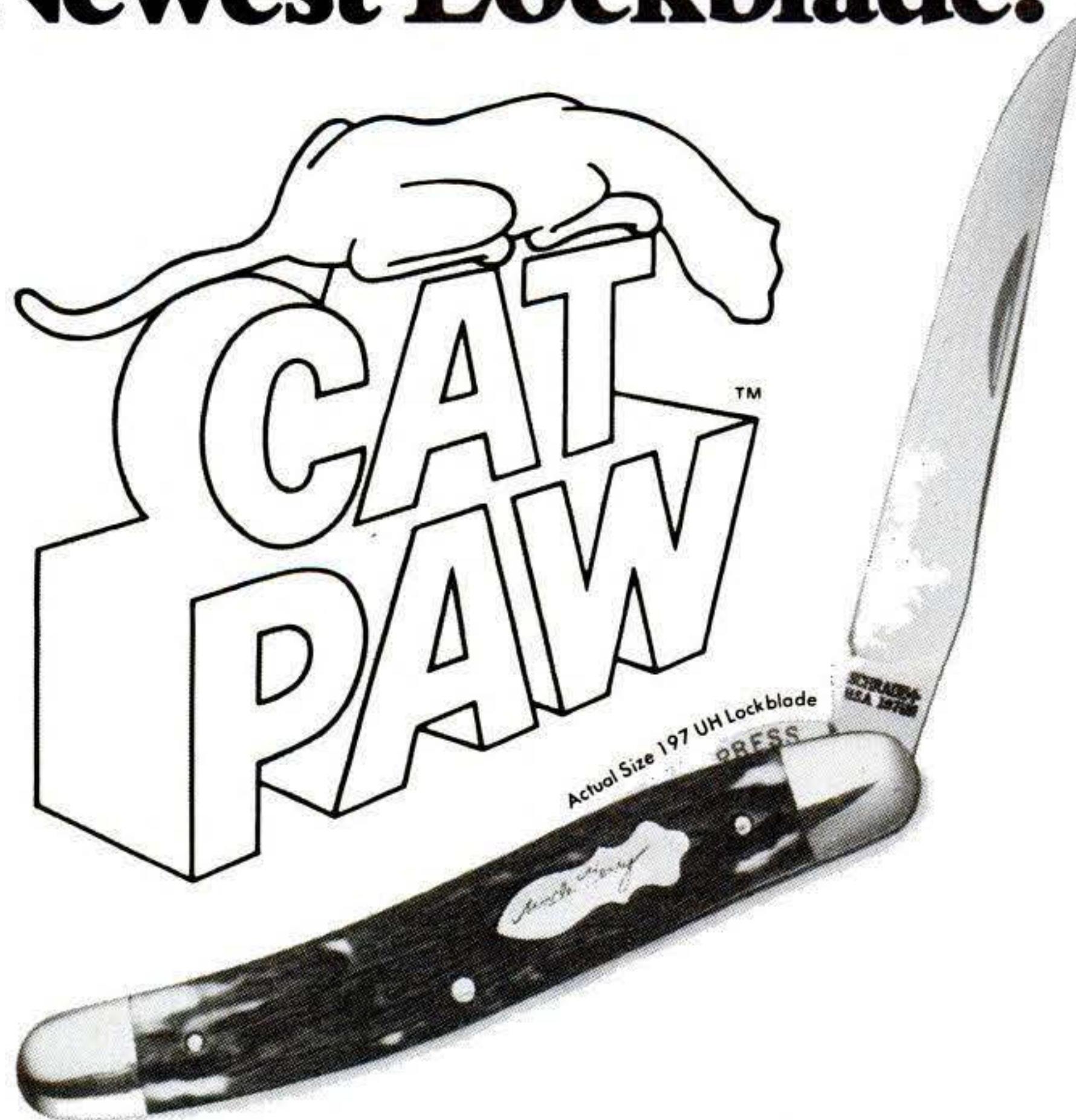
Backfire in the exhaust is clean air hitting hot exhaust gas that's rich enough in carbon to react when oxygen content is increased. Flame is already there to complete the reaction cycle. Stop the overrich condition or oxygen entry, and the noise will leave. Caution: Even a leaking exhaust valve upstream can trigger this.

Wants more mpg

I have a '72 Hornet. All I can get is 12 to 14 mpg. The engine had a valve job and the carb rebuilt. New spark plugs and points

Continued

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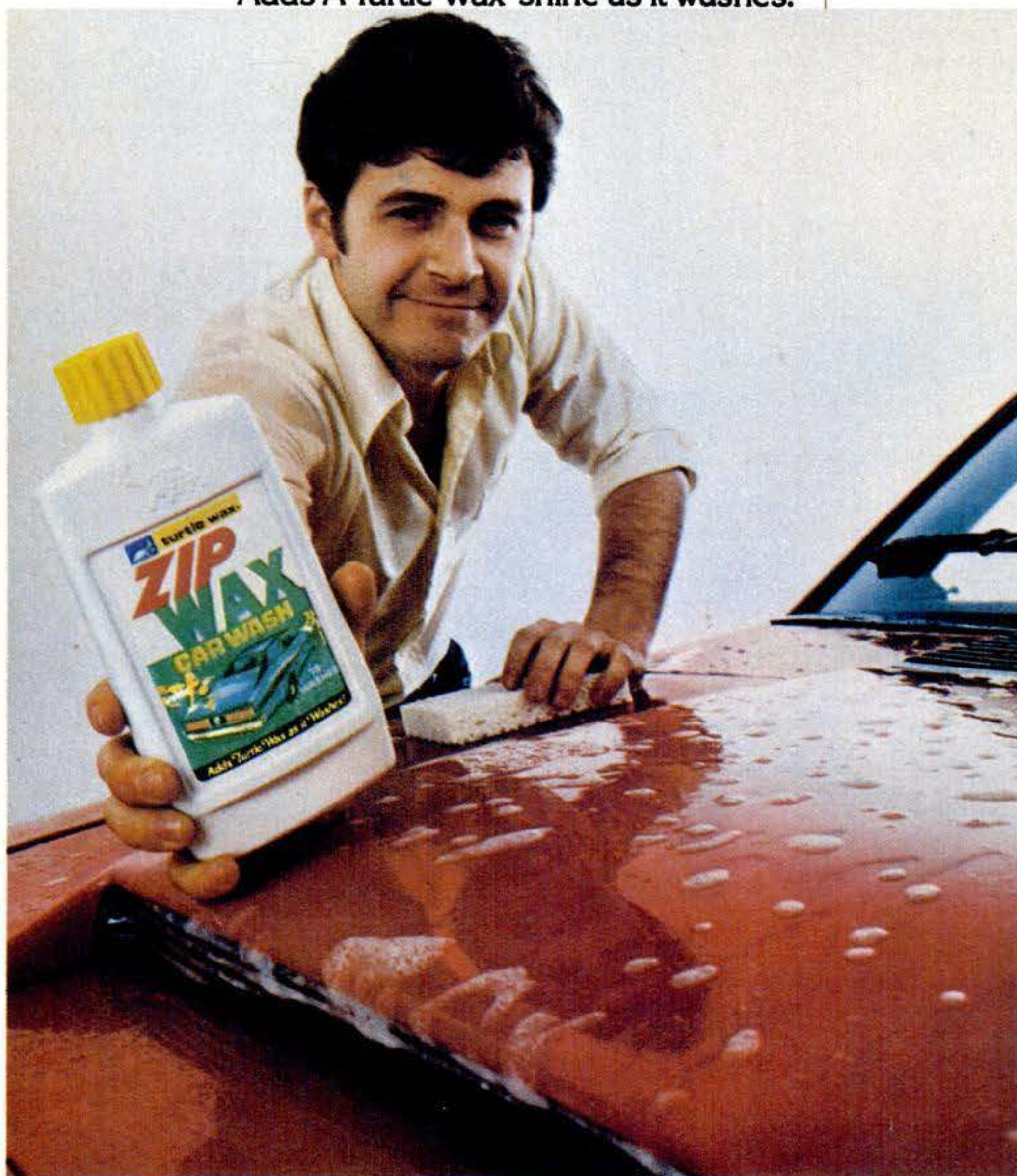


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"Say Smokey—"

[Continued]

were installed. What can I do to get better mileage?

Edward Oakley, St. Petersburg, Fla.

Install a tach and observe engine rpm at 55 mph. Do what you have to or can afford to do to get 55 mph at 1500 rpm. That's the biggest help. Choke timing and the carb must be right, but there's no dramatic help there.

Wet question

What do you think about water injection for the average motorist?

Waclaw Kibort, Island Lake, Ill.

Water injection is good for reducing flame speed and can, for example, stop a car from pinging on a fuel that is maybe two to four octane off.

Charging batteries

I have a Sears 12-volt battery charger. Since this battery charger comes with instructions for charging old-style, add-water batteries, I wonder if I can use it to charge the new maintenance-free types of batteries.

Martin Soss, Monroe, N.Y.

So-called new batteries are not to be taken as more of yesterday's. They can be dangerous to your health and be damaged unless charged according to specific instructions.

We are having more battery trouble than we ever had. I'm not sure the old lead-acid battery has been bettered yet, all aspects considered.

Should he drive in second?

I tow a 4000-pound travel trailer with a '73 Mercury Marquis 460. My vacuum gauge indicates a three-to-five-mpg increase at speeds of 40 to 60 mph when I drive in second gear. This is the case whether I'm traveling level, uphill, or downhill.

I know the motor runs faster in second gear. Do you advise driving in second gear when towing a trailer?

Len W. Bailey, Kempton, Ont., Canada

For mileage, leave it in third. For longer engine life, drop back to second when the engine starts lugging.

Which route is best?

I live in eastern Pennsylvania where there are many hills and valleys. Would I get better gas mileage and less engine wear on my four-cylinder compact by driving a 20-mile, fairly level road instead of a shorter, 16-mile course involving both downhill stops and three- to four-mile uphill climbs (where my automatic transmission is almost constantly shifting and re-shifting)?

Bill Yagley, Freeland, Pa.

The flat-road, steady-state throttle position on the 20-mile course should be the economy route both on maintenance and mileage.

Continued

POLICE RADAR MEETS ITS MATCH.

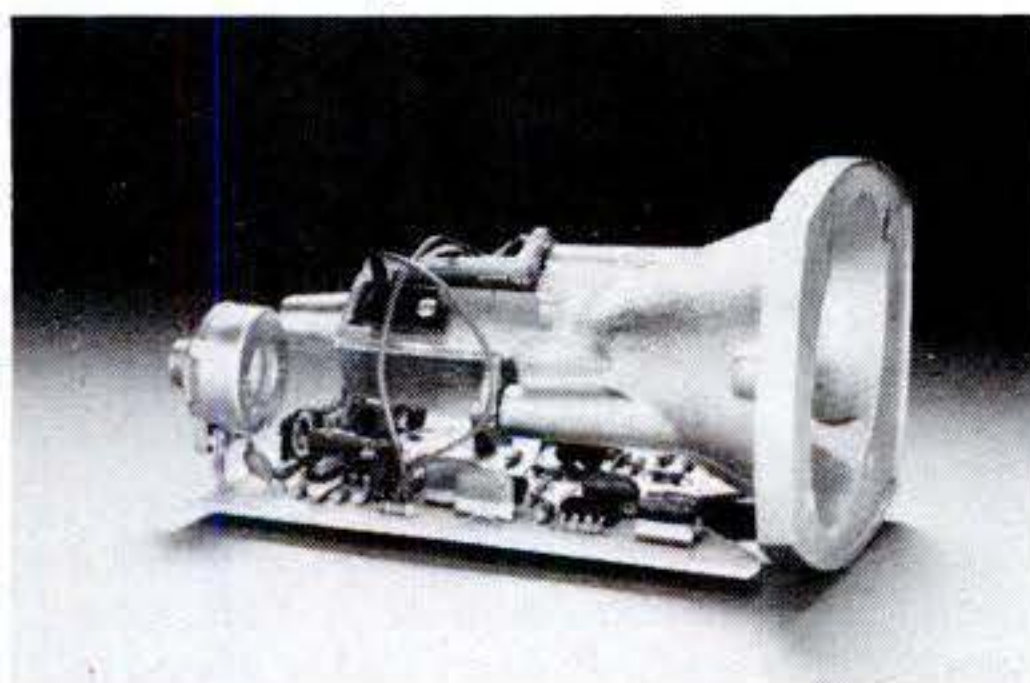


You can't buy a better radar detector for \$95 than the GUL Micro Scan. Developed by B.E.L. Laboratories after 10 years of research, the GUL Micro Scan has repeatedly proven its superior signal sensitivity. In separate tests conducted by Canadian Tire Corporation and *Motor Consumer Report*, it demonstrated a detection distance significantly greater (on both X and K bands) than its top three competitors—the Fuzzbuster XK, the Whistler XK and the XK Snooper.

That was only the beginning.

Plenty of advance warning.

In two recent issues (January and February, 1980) *CB Magazine* revealed an unprecedented comparison showdown involving 12 leading detectors—



Large elliptical horn antenna detects radar from all sides, even when approaching hills and curves.

some with prices as high as \$200.

Monitoring straight line detection, the GUL's 9,029 foot range topped the list.

Signals of .01 millionths of a volt are

sufficient to trigger the GUL's scanning alert system (ranging from 9.445 to 24.445 GHz). It successfully detects all police radar—including the new KR-11 short pulse.

What's more, the GUL has a nondirectional antenna; its large elliptical horn pulls in signals from front, side and rear. This 360° detection field maximizes sensitivity, providing you with valuable warnings—even when approaching hills and curves. *CB Magazine's* comparison bears this out: In a K band test for around-the-curve sensitivity, the GUL's detection range was double that of the Fuzzbuster and Super Snooper. And nearly three times greater than the highly regarded Whistler. On X band pickup from the side and from behind, it was found to be the most effective detector in the dozen.

Doesn't cry "wolf."

The most common problem among radar detectors is the failure to screen out false signals, such as signals from taxis and ham radios, as well as hospital microwaves.

But the GUL shows no sign of falsing when exposed to radio signals of any kind. Its sophisticated circuitry is completely shielded by a diecast and extruded aluminum case which protects

the input terminals from stray signals (the most common cause of false alarms). The aluminum provides lightness, along with durability not found in plastic casings.

A double warning system.

Both a tone and light come on in the presence of radar, and remain on until radar is gone. You're never lulled into a false sense of security by a tone that sounds once and then goes off. You control the tone with a front-mounted on/off switch.

In addition, the GUL uses an internal voltage regulator, commutating filter, and synchronous detector to reduce power consumption to a minimum. This also provides a more stable gain setting. And its gain control knob lets you optimize sensitivity for different city and country conditions.

Quick installation.

The compact GUL measures only 4" x 3" x 4½". It weighs just 20 oz. Its case is finished in glare-free matte black, and comes with bracket in place.

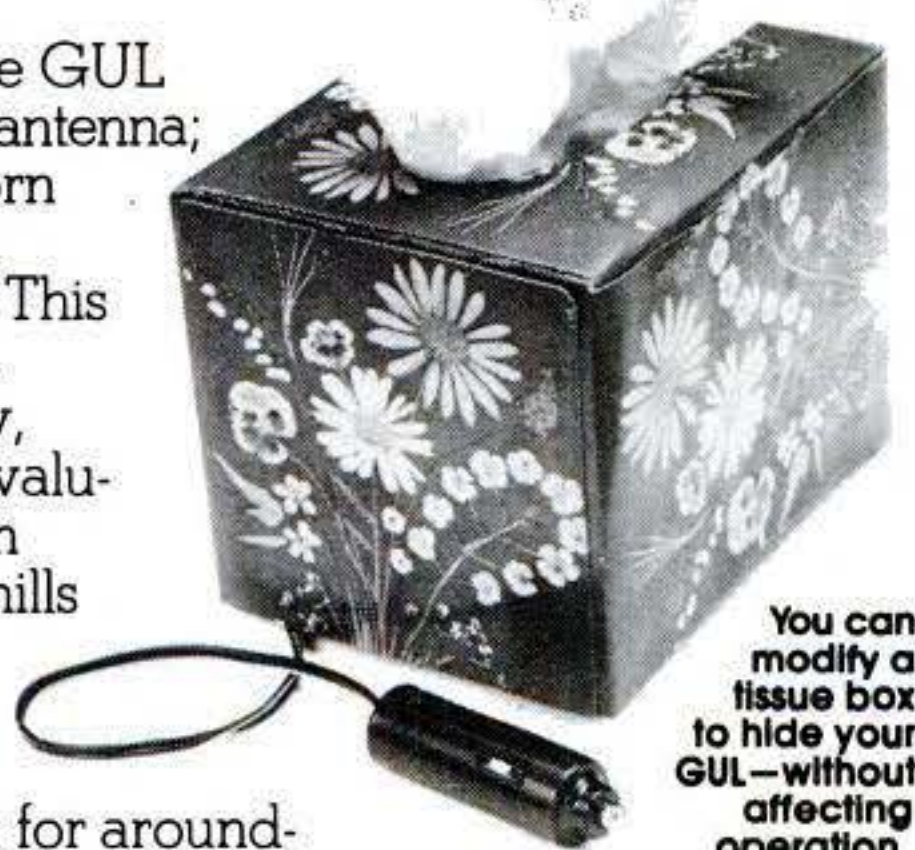
To mount, simply fasten the adhesive Velcro pad to the top of your dashboard; a matching Velcro foot (on bracket) keeps the unit securely anchored. This

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— Jack McAlister
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"Say Smokey—"

[Continued]

Wants to run alcohol

What changes are required for using 95 percent alcohol in a fuel-injection gas engine such as the one in a gas Rabbit?

Charles A. Swanson
Huntsville, Ala.

Charlie, forget it unless you just want to prove a point.

Two giant problems: You need to double fuel flow, and oxidation is going to get you. It's tough to convert a carburetor, but fuel injection is even tougher.

Wants a step van

In spite of the current gas prices and problems, I'm considering the purchase of a one-ton, long-wheelbase step van for use as a multi-purpose vehicle.

About 500–700 lbs. will be permanently added to the net weight of the van. The cargo will vary from a few hundred pounds up to about 1000 lbs. on rare occasions.

I would like to be able to cruise smoothly at 55 mph with a little reserve power for small hills or for passing.

What do you recommend for engine size, type of transmission, and rear axle ratio?

R. W. Born, Canon City, Colo.

Look for about a 300-cu.-in. engine with lots of low-end torque. You need an over-drive manual transmission so you can do 50 mph at around 1500 rpm. Avoid wide, aggressive-treaded tires. A four-barrel carb is best, I believe. Don't load up with electrical drains and power-eating extra equipment.

Turbo-charging a small engine is the answer, but it's still not available in the truck you want.

A tough problem

Since air is approximately 20 percent oxygen and 80 percent nitrogen, why not run the incoming air near the exhaust to heat it, then run it through something equivalent to a catalytic converter to reduce the nitrogen component, thereby increasing the oxygen percentage? It seems to me the gasoline would burn more completely, mpg go up, and pollutants be reduced before they get to the exhaust.

Kurt Lindquist, Atlanta, Ga.

I've been trying to do what you suggest for 28 years. I only know about 50 ways it didn't work. If you could do it, California would erect a 500-ft.-high statue of you in the middle of L.A.

Each month in *Popular Science* Smokey Yunick answers questions on cars—family cars, high-performance jobs, hot rods, and racing cars—selected from those sent in by readers. Got a problem? Send it to: "Say, Smokey—," *Popular Science*, 380 Madison Ave., New York 10017. Questions cannot be answered by mail.

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The adaptable Antelope

—from gunboat
to laboratory

It looks as if the Environmental Protection Agency (EPA) has decided to heed the biblical injunction to "beat swords into plowshares."

Once a Navy gunboat stationed in the Mediterranean, the 165-ft.-long U.S.S. Antelope was designed for military activities such as blockading and surveillance. But for her new role as an oceanographic survey vessel (OSV), the Antelope has been thoroughly refitted to collect and analyze samples from ocean disposal sites.

As a Navy ship, she carried a crew of 30 in addition to her surface-to-surface missiles, a 40-millimeter cannon, and twin 0.50-caliber machine guns. Now, instead of missiles and guns, she carries three sophisticated shipboard laboratories, box corers, grab samplers, and dredges. Her crew of boat-swains and gunners' mates has been replaced by scientists and shipboard engineers. And Antelope now cruises

the coasts of the United States, down the east coast from Maine, to Puerto Rico, through the Panama Canal, and up the west coast as far as Alaska.

The Interstate Electronics Corporation of Anaheim, Calif., operates the revitalized Antelope under contract to the EPA, which is responsible for establishing and monitoring offshore waste disposal. "The Antelope's role is to collect the initial data and continue the monitoring process for the EPA," explains Jerry Bane, general manager of oceanographic engineering for Interstate. "The samples collected by her scientists are preserved for more detailed analysis by shore-based laboratories." And besides helping the EPA monitor disposal sites, the Antelope collects data on natural accumulations and shifting of sand and silt, which can cause navigational problems in harbor and port areas.

The result of the Antelope's efforts is a series of detailed environmental-impact statements, documents that can take up to nine months in preparation and that are crucial in as-

sessing the environmental effects of dumping and other forms of disposal. When she comes home later this year, after a year and a half at sea and two circuits around the U.S., she will have helped prepare 26 of these impact statements.

Although legislation controlling waste disposal into American waters has been in effect for almost 100 years, it wasn't until 1972 that the Marine Protection, Research, and Sanctuaries Act granted the EPA the responsibility for monitoring ocean disposal activities. Until that time, no one agency could enforce dumping restrictions, and regulation of ocean disposal sites was, in fact, nonexistent. "The job of the Antelope now," according to Bane, "is to help the EPA turn that regulation into a reality."

—Harriet Brown



Refitted Antelope cruises U.S. coasts as a floating laboratory.

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PS | What's News

When Paul Bolon began collecting locks for this month's cover story, we noticed a surprising thing. A lot of locks looked quite different from those we're used to seeing. And keys were different in some cases, too.

The new look is not cosmetic. It reflects a new wave of lock technology. The lock manufacturers are fighting back against the wave of burglary that has homeowners and apartment dwellers worried these days. As a result, the new locks are stronger, harder to pick, more difficult to defeat. They can make your home more secure against intruders.

But while the new locks may offer better protection than the older ones, remember that no lock is foolproof. While almost any lock can stop an amateur, the professional burglar can get through anything, given enough time. That's why multiple protection is so important. Install two strong, hard-to-defeat locks instead of just one. Remember, your best strategy is to make it tough for a would-be housebreaker—tough enough to make him decide that your house isn't worth the trouble and turn his attention elsewhere.

Of course, doors are just part of the problem when it comes to protecting your home. Most windows are pretty easy to get into, as well. That's why we'll be following this piece with another on window and sliding-glass-door security. This month's article on door locks starts on page 128.

Gasohol

President Carter's call for the country to produce 500 million gallons of ethanol for use in gasohol by 1981 still leaves some unanswered questions. The main one was brought up in Ray Hill's comprehensive article on gasohol and its future prospects in the March issue of *POPULAR SCIENCE*. The question, of course, is this: Do we actually gain anything by making gasohol? The answer, if we continue to make ethanol mainly by burning oil, is no. Of course, there are other nonconventional methods that might produce a net energy gain, but there has been no mention of them in the administration's plan.

The principal motivation for increasing the supply of gasohol, of course, is to cut back our dependence on foreign oil. The Carter proposal, which would replace an estimated 10 percent of the unleaded gas-

oline in the country with gasohol, would appear to move in that direction. But the problem comes from the fact that it takes a lot of oil to make the alcohol used in gasohol. Gas or diesel fuel is used in planting, cultivating, and harvesting the corn, which is the raw material. More fuel is used transporting it to the alcohol distillery; yet more in distilling it. Battelle Laboratories, in a study undertaken for the American Petroleum Institute, says that for each Btu of energy you get from alcohol, you've spent 2.2 Btu of petroleum energy to make it. That's not a very good deal when it comes to cutting back on oil imports; in fact, the more gasohol we make, the more oil we'd need to make it. As one energy expert put it, that's like spending 10 dollars to make five.

The solution, as Ray pointed out in his article, is to use other forms of heat energy to distill the ethanol. Theoretically, you could burn the corn stalks to heat the stills and make ethanol, but that presents a hauling and storage problem. If sugar cane were used (instead of the corn now in the plans), the bagasse (the cane stalks left after the crushing and pressing process that removes the juice) could be burned to supply enough energy for the distillation. That's the process used for most ethanol production in Brazil, where gasohol is helping to reduce petroleum consumption.

Another possibility is to use coal for the production of ethanol from corn. Some oil would still be required for planting, cultivating, and hauling, but we would get back more Btu from the alcohol than we would use in the form of oil. Still another ingenious idea: TVA informed the Department of Energy that it is considering using waste heat from power plants to make ethanol, thus raising the overall efficiency of its plants and making a useful product at the same time.

None of this has been discussed in any of the reports we've seen. Most of the conversation has simply concerned whether it would be possible to build enough plants to increase production from the current 80 million gallons a year to more than six times that—and do it this year.

Meanwhile, gasohol distribution continues to increase. Texaco has introduced the 90-percent-gasoline/10-percent-ethanol mixture to Washington, D.C., and will soon begin marketing it in perhaps as many as 600 stations in Maryland and Vir-

ginia. That will be in addition to the 600 Texaco stations now selling gasohol in nine states. And Amoco will soon be selling gasohol in 600 stations in Iowa.

Flywheel progress

When Susan Renner-Smith reported last October on the flywheel that may power your house, researchers at the Lincoln Laboratories of MIT had built only a small model to test the effectiveness of the magnetic-bearing concept. Now, Alan Millner, project director, reports the team has built a 400-pound steel flywheel capable of storing one kilowatt-hour of electrical energy, and tested it up to 12,000 rpm. The magnetic bearing worked as expected. Next, the team is going to substitute a 400-pound, low-cost, high-strength composite flywheel from Johns Hopkins [PS, Jan.]. Since it will be stronger and larger, it will store five kWh of energy. The ultimate goal is a system that will store up to 40 kWh, since the average household uses about 25 kWh a day. The energy could be generated by solar cells on the roof, by a windmill, and, when necessary, by cheaper, off-peak power from the local utility.

Maglev speed record

The experimental Japanese magnetic-levitation vehicle [PS, Aug. '79] has set a new ground-speed record of 504 kilometers per hour (313 mph). The car, floating above its track and propelled by a linear-induction motor, has just about exhausted the speed possibilities of the seven-kilometer test track. Now, the Japanese National Railway will modify the track for tests with a new 10-passenger car. The third phase will be construction of a 40-km test track. JNR hopes to have maglev trains in regular service between Tokyo and Osaka by 1990. The trains should make the 483-km (300 miles) trip in one hour.



Editor



Baldtop Dugout in Lyme, N.H., is home of architect Don Metz, its designer. Two-story underground house has spectacular view of mountains (right). Most glass is on south side for direct solar gain. Mass of structure (80 tons of masonry) acts as thermal storage; walls are insulated on the *outside* with two inches of urethane. Combination wood/oil furnace supplies backup heat as needed. Heavy timbers support the roof, which has three inches of urethane insulation and eight inches of soil on top.



PHOTOS ON
THIS PAGE
BY ROSS CHAPPLE

Solar goes underground

in new house designs

The earth and sun work together to make these houses energy-efficient

By V. ELAINE SMAY

If you think an underground house is a dark, musty windowless burrow where only a few eco-freaks—or moles—would live, the idea of a *solar* underground house may sound like a contradiction in terms. Or perhaps it brings to mind a cave topped with an array of solar collectors.

True, some underground houses are heated by active-solar heating systems. And a few haven't much natural light. But the great majority of underground houses being built today have large banks of windows that flood the interiors with sunlight and supply much of the heat they need.

Solar and underground are compatible concepts indeed—for many reasons. First of all, underground houses must be massive structures to withstand the tremendous pressure of the earth around and above them. Usually they're made of reinforced concrete—a lot of it. Those tons of masonry are not only structurally massive; they're thermally massive. And that's just what you need to smooth out the dips and peaks in temperature when you heat with an intermittent source like the sun. When the sun is shining, the walls and floors slowly soak up heat; as the air temperature in the house cools, they slowly release that heat. In above-ground solar houses, great quantities of masonry or water must be used just for this purpose. In an underground house, it's got to be there anyway.

An underground house is much easier to heat than an above-ground

house. That means the solar-heating elements can be smaller. "It's not that the earth is such a terrific insulator," explains Dr. Ray Sterling, head of the Underground Space Center at the University of Minnesota, one of the country's leading research and information centers on underground construction, "but when you use a lot of it, dirt is an effective moderator of temperature."

Dr. Sterling is a young Englishman with an appropriate accent and some ready numbers to prove his point. "In Minnesota," he explains, "we have an air-temperature range of 130 deg. F annually: from -30 degrees in winter to 100 degrees in summer. But the temperature of the soil, if you dig down just 10 feet, swings only 20 degrees—from 40 to 60 degrees. Even immediately below the surface you have only a 40-degree annual swing. And there's practically no daily swing."

Heat loss from a building is due in part to heat transmission through the walls. As long as the outdoors is cooler than the indoors, heat will flow out. The greater the temperature difference, the greater the heat flow. Consequently, when your house is surrounded by 50-degree dirt rather than zero-degree air, you cut heat losses drastically. Building a house underground also reduces the heat lost through infiltration, and shelters it from wind.

In summer, an underground house is much easier to cool. While a house above ground gains heat all day from the hot surrounding air, an underground house loses heat to the 50-60-degree earth. Most underground houses need no air conditioning.

All of these benefits are capped by another unique advantage of building

underground. The earth acts like a giant thermal flywheel. The soil at 10 feet reaches its coldest temperature not in January, when the air is coldest, but about three months later, just as the air is probably getting warm. And it reaches its warmest three months after summer wanes.

The combination of very high thermal mass and very low heat loss makes an underground house slow to cool off, even if it should lose its heat source. John Barnard, one of the pioneer "underground" architects, tells of a house he designed that was built near Casper, Wyo. "Last February," says Barnard, "the owner was having some trouble with his furnace, so before he went away for a week of skiing he just turned the thing off. Outside temperatures went well below zero for several stretches. But the house never got below 55 degrees."

Other advantages

An earth-sheltered house is much quieter than conventional structures. Outside maintenance is greatly reduced. And since it's primarily of masonry, it's rot- and vermin-proof, and probably more fire-resistant than a frame house.

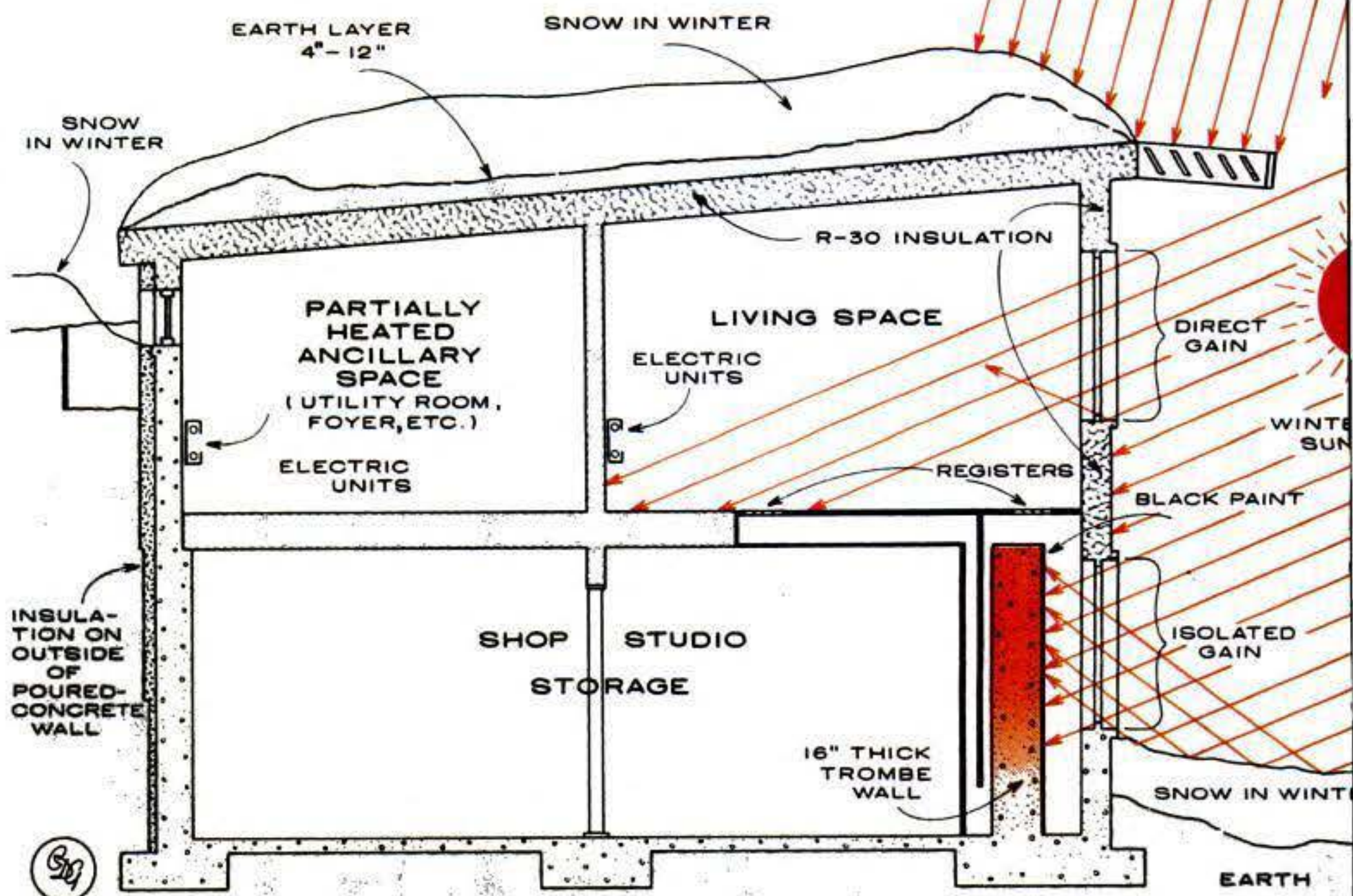
It is also sheltered from wind and hail and other extreme weather conditions. "One stormy afternoon a tornado was spotted just a few miles away," relates Frank Moreland, a tall, soft-spoken Texan who has an architectural practice in Fort Worth and teaches at the University of Texas at Arlington. "Twenty-two neighbors decided it was a great time to visit a new underground house I designed."

Some people build underground to preserve the land for other purposes, such as gardening or recreation,

Continued

Award-winning house— designed, built by owner

"Underhill" (photo, far right), home of Tom and Jill Newhouse in Grand Rapids, Mich., has direct-gain south windows on upper story, Trombe wall below. Diagram shows winter day. At night, registers in floor of living space are opened to admit warm air from Trombe-wall cavity. Thermal shutters, drapes cover glazing. Owners monitored house first year: From Nov. 1, '78, to Mar. 31, '79, with only 30 percent sunshine, house used half the heat a very well insulated conventional house would need. In Feb. '79, after house had stabilized, it used only a third as much. Wood stove and electric baseboard heaters provide backup heat. In summer, slatted overhang shades windows. Casement windows on south and small north windows open to provide cross ventilation. House loses heat to cool surrounding soil. There's no air conditioning; hottest house got was 78.5 degrees F. Underhill won a DOE/HUD passive-solar design award.



to leave the landscape undisturbed. "It's my gut feeling that somewhere between 2000 and 3000 underground houses are now being lived in or are under construction across the country," says Chuck Lane, associate director of the Underground Space Center. "And by far the primary reason for building underground is to save energy."

Just how much energy do these houses save? Estimates start at about 25 percent and go all the way up. Architectural and engineering firms that have designed a number of them usually claim around 50 percent savings. Certainly the amount depends on the climate, the people who live there, and the design of the house itself. And there are many design ap-

proaches to underground solar houses, as our photos show.

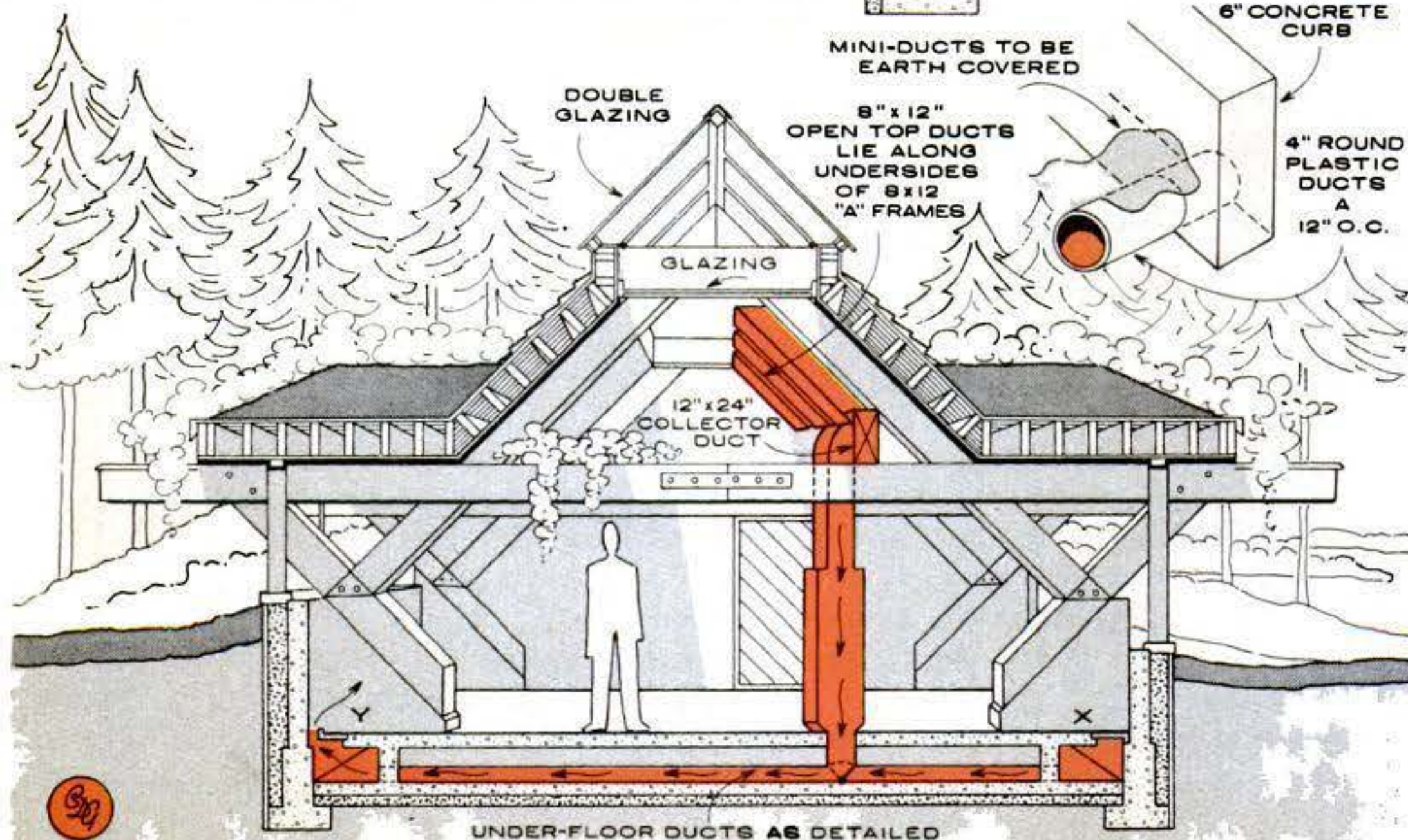
Ninety-five percent solution

Paul Shippee of Colorado Sun Works in Boulder decided to go all out to design an earth-sheltered passive-solar house that would combine minimum fuel use with maximum reliability and comfort. The 1820-sq.-ft. house in Longmont, Colo., has eight-inch-thick poured reinforced-concrete walls, insulated on the outside, and 300 sq. ft. of glazing on the south. The central section of the south glass admits sun directly to the living space. Behind the rest are 55-gallon drums—54 in all—painted black and filled with water. The glazing is Beadwall: A 5½-inch space between two layers of glass is automatically filled with tiny Styrofoam beads on cold winter nights, insulating the glazing to a rating of R-20. As the sun warms the panes, the beads are vacuumed out.

The Shippee house has been closely monitored since its completion in

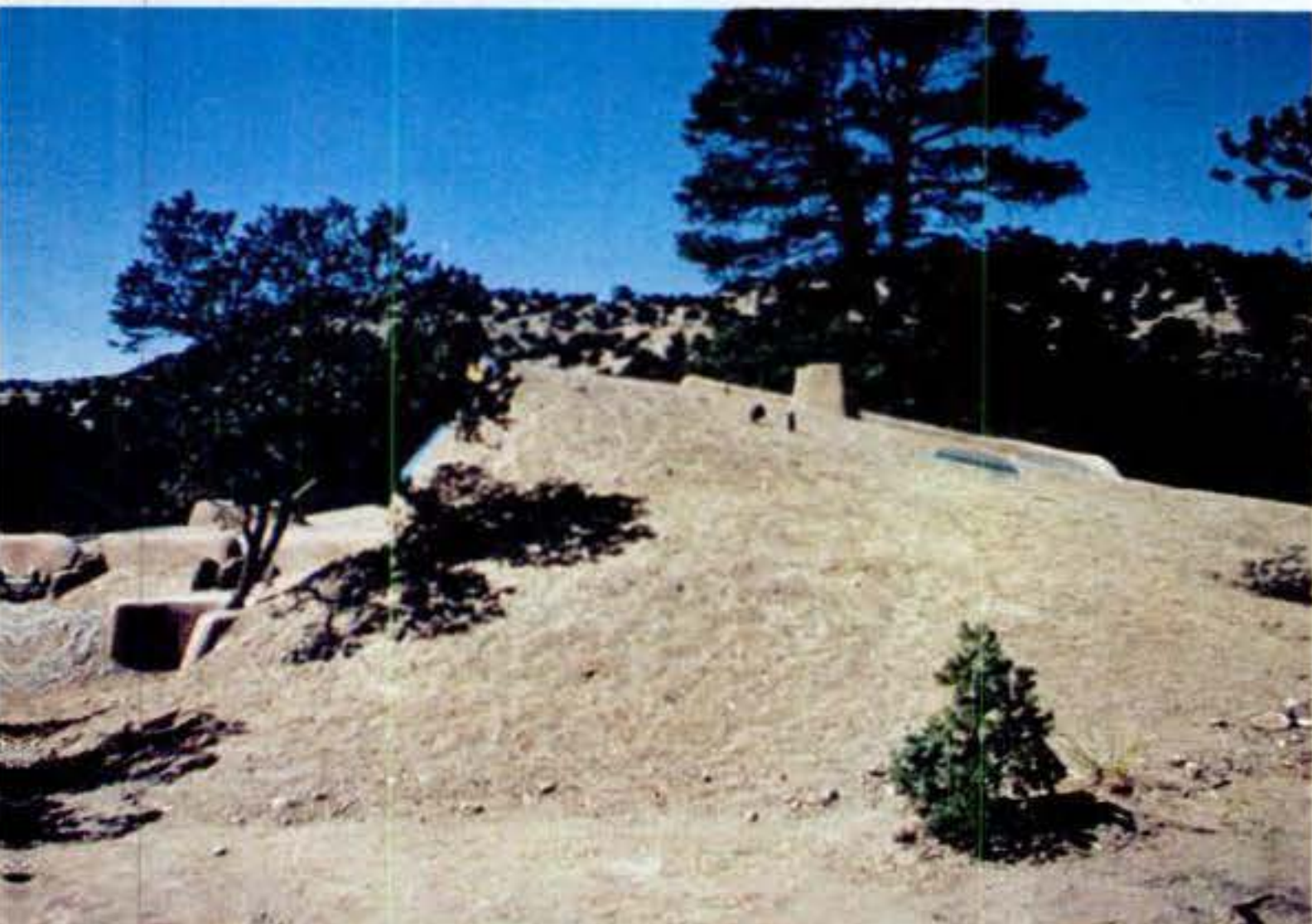
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Passive-solar design for an east-facing site



New home/office (left) of architect Malcolm Wells is on "problem" site on Cape Cod. The problem: A beautiful view of Upper Mill Pond is to the east, not to the south, where the glass should be for passive-solar heating. Solution: A triple-glazed skylight running the full 110-ft. length of the 26-ft.-wide building to collect solar heat; plus earth berming, earth cover, and heavy insulation (six-inch Styrofoam on upper walls) to hold the heat. Solar heat collected by skylight (and heat from oil furnace when needed) is pulled into under-floor plenum, which is tightly sealed on one side to pressurize, and open on the other to supply warm air to the house. Earth-covered plastic ducts in plenum channel heat. Plenum will store enough solar heat for four or five days.

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"Suncave," near Santa Fe, N.M., blends into its environment winter and summer. Striking contemporary design has flavor of indigenous adobe architecture. Architect David Wright of the SEAgroun in Nevada City, Calif., designed house for builder Ka-



ren Terry. Owner is Dan Fitzgerald. Vertical double-glazed south windows and clerestory provide direct solar gain. Structural adobe, concrete, and brick floors store heat. Two adobe fireplaces are only backup heat source. Sun supplies 86 percent of heat.

Top of solar atrium projects from beautiful sod roof of Bill and Marilyn Mohler's home in Dublin, Ohio. Atrium is solar collector for the house. Sun, shining through Kalwall glazing on its south face, is absorbed by 12-in. thick masonry wall on north. Heat is transmitted throughout house. House was engineered by Don Secrist, president of Solar-Earth Energy, Inc., in Columbus;

builder was Buck Vaile. Airtight wood stove provides remaining heat; electric baseboard heaters have never been used. Active solar collector preheats domestic water. Living-dining area (right) connects to atrium via glass doors; east-facing windows give more light and view across Sciote River. Secrist's plans call for south-facing window wall, but view took precedence.





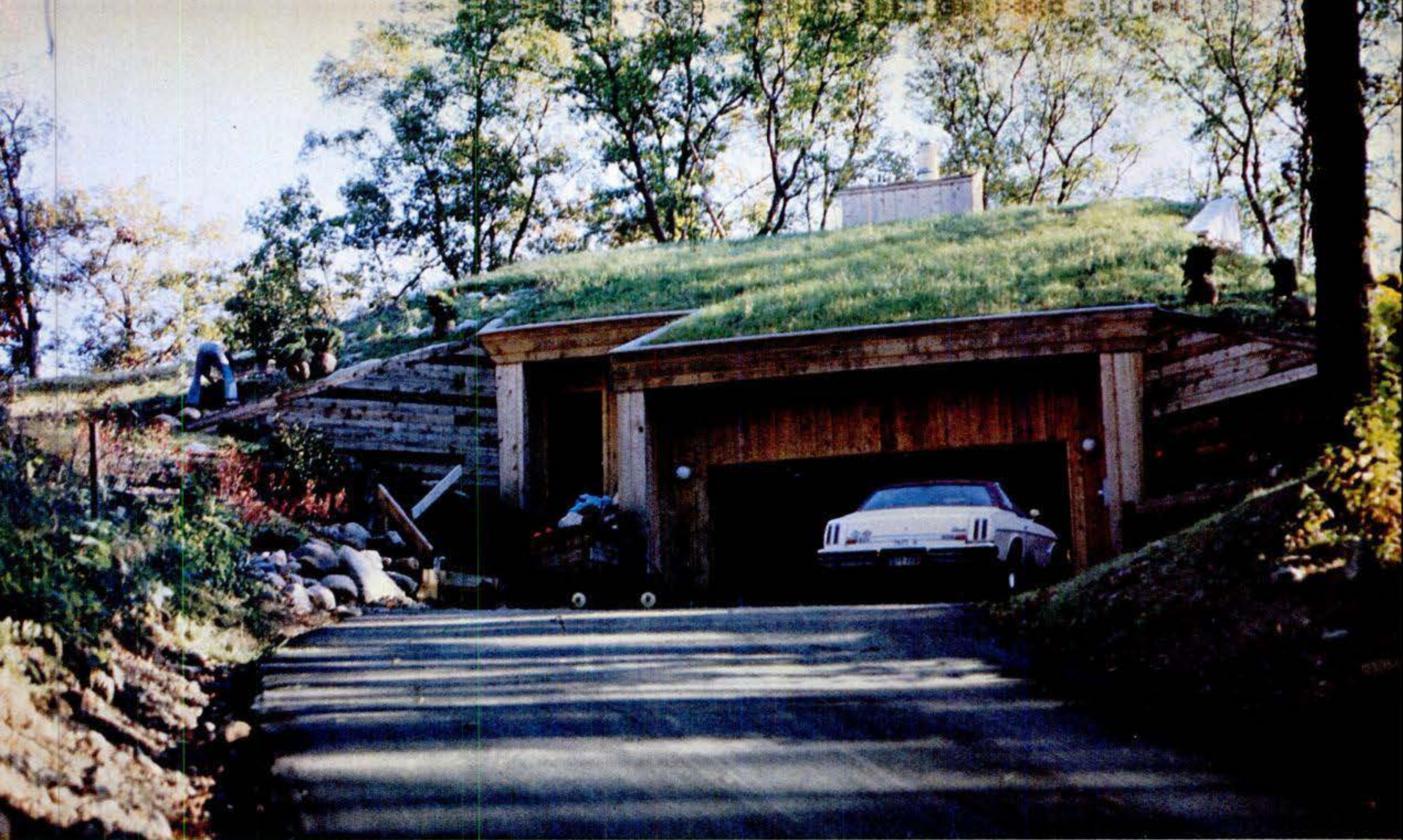
spring 1978. A remote sensing system was designed by Boeing Aerospace, and 90 sensors were installed during construction. The results are analyzed by IBM. "A year's worth of computer printouts stacks up taller than me," says Shippee.

The results have been impressive. "Throughout our extremely cold 1978-'79 winter, the backup gas furnace was never used," Shippee reports. In January '79, for example, lights, appliances, and the resident family of four provided 17.2 percent of the heating needs of the house, the fireplace provided 5.8 percent, and the passive solar features met the remaining 77 percent. Average daily temperature swings were kept below six degrees. The lowest temperature recorded in December '78 was 63 degrees F, when the outside temperature dropped to -20 degrees; the highest recorded that month was 81 degrees.

Continued

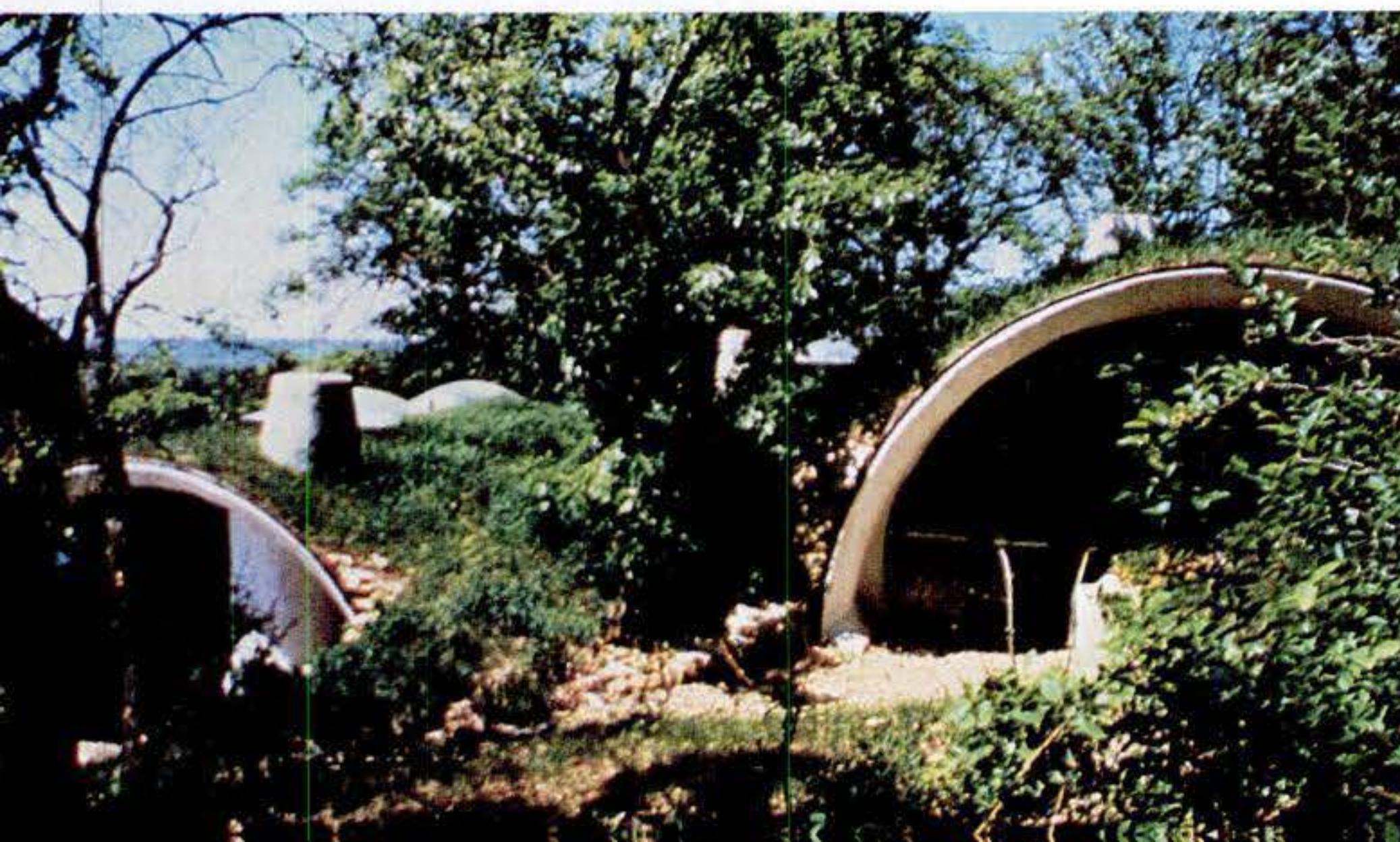
A dozen townhouses, two miles from downtown Minneapolis, are sheltered from noise of adjacent freeway by earth cover. Architect J. Michael Dunn of Close Assocs., Minneapolis, designed the project for Seward West Redesign, a neighborhood housing development corporation. Solaron air-type solar collectors, paid for by a HUD/DOE grant, are to supply about 45 percent of space heat; rock storage bins will hold enough heat for two cloudy days. South windows will supply another 25-35 percent of heat. A gas furnace will provide backup heat. Active solar system will also preheat domestic water.





Niched into south-facing slope in Burnsville, Minn., this 2100 sq. ft. house was designed and built by Carmody and Ellison. Builders won \$17,000 grant from Minnesota Housing Finance Agency in innovative state-sponsored program to promote earth-sheltered housing. House has abundant south glazing for direct-gain solar heating and uses only structure of house (reinforced concrete block) for heat storage. This, and other six houses in program, will be monitored by the Underground Space Center for five years.

Two-story direct-gain house, by architect Ed Romo of Northeast Homeplanning and Design, Brighton, Minn., nestles into bank of cul-de-sac in Minneapolis suburb. House is only 25 ft. deep, so south windows light all of living area. Section over door is angled to hold future solar panels for domestic hot water. Backup wood stove and gas furnace are connected to standard duct system. Plans called for straight retaining walls, but putting bends in meant less massive—and less costly—walls.



Two parallel steel drainage culverts connected by a tunnel form this delightful house in River Falls, Wis. Sprayed-on polyurethane foam insulates the structure. Architect Michael McGuire, Stillwater, Minn., designed the house for Pat Clark. Built in 1972, the cost was considerably less than for conventional construction. But the price of steel is up sharply, so the economics would not be as favorable now. However, a few architects and builders are beginning to use concrete domes for underground houses. A dome, like an arch, is inherently strong under load and is advantageous for such use.



Attached greenhouse is solar collector for house by David Wilson and John O'Keefe of Earthworks in Bucksport, Me. It is separated from living space by massive Trombe wall, which isolates house from day-night temperature swings in greenhouse. Architects report that sun provides half of heat house needs. Airtight wood stove is only other heat source; exhaust gases are channeled through eight-foot long horizontal flue in masonry wall to extract additional heat. Family used 2¾ cords of wood first winter. Four-bedroom, 1500-sq.-ft. house, designed to be affordable as well as energy-efficient, was built for \$36,000 in 1978.

South-facing windows on two stories and clerestory windows above provide solar heat and light for this underground home in Atlanta. Mass of building materials stores heat. Overhangs and trellises keep out high summer sun. Vegetable garden graces most of roof. House is by Jack Schupp and Richard Lang of Energy Efficient Environments, Inc., Atlanta.

In summer, a slatted overhang shades the south glass from the sun. At night, the house is ventilated and the 60-degree Colorado night air cools the massive house. On hot days, it's closed up to stay cool.

If a house is to be energy efficient, it must be designed for the climate.

"In Texas we have six weeks of winter but six months of summer," says Frank Moreland. Consequently, in the houses he designs, he orients most of the windows to the north. He also prefers to cover his houses with at least seven feet of earth—one to two feet is typical in most climates. "With seven feet of earth above," he explains, "you have summer temperatures hitting the house in October, fall temperatures hitting it in the spring, and spring coming through in the summer." And he uses no insulation, so the house can readily lose heat to the cooler earth around.

Building underground doesn't involve advanced technologies, but it does demand some special considerations. First, the structure must be engineered so that the roof and walls can readily support the tremendous loads involved. Since failure could be catastrophic, it is essential that an engineer or architect be consulted.

The other prime consideration when building underground is making sure the house doesn't leak. There are a variety of effective waterproofing systems, but if you try to water-

proof an underground house as you would a standard basement, chances are it will leak—like a standard basement.

Other special problems: Finding an appropriate building site may be more difficult; building codes may be harder to abide by; and it may be harder to get financing. It may also be tough to find a builder.

An underground solar house *may* cost more than conventional construction, although not necessarily. But the life-cycle cost, calculated over the life of the mortgage, should look very favorable, even if a higher initial cost is involved.

Earth-covered villages

The Seward Townhouses in Minneapolis (see photo) may presage a whole new era of earth-sheltered multifamily houses and villages. Energy Efficient Environments, an architectural firm in Atlanta, has designed a 144-unit, earth-sheltered, passive-solar apartment building that's just getting under way in that city. And two more are on the boards for Arizona and California, notes Richard Lang, president of the firm.

Frank Moreland foresees whole earth-covered villages. "They could be built at three times the density of today's suburbs and still have 50 percent more green space. In mass production, these could be built for two-thirds the cost of today's tract hous-

ing," he believes. "And once you get to a density of five or six houses per acre, you can support a mass transit system, and reduce reliance on cars."

Don Secrist, of Solar Earth Energy, Inc., in Columbus, Ohio, would like to see everyone keep his car and run it on alcohol produced in self-sufficient, underground, passive-solar villages, which would have all the luxuries and conveniences we have today. "We could maybe find 40 million Americans who are willing to adopt a more primitive lifestyle to save energy and preserve the environment," he speculates, "but it's the other 200 million I'm after now." DS

FOR FURTHER INFORMATION

Popular Science: "Passive Solar," Apr. '78; "Underground Houses," Apr. '77; "Low-Technology Solar Homes," Dec. '76; "Underground Living," June '74.

Universities: Dr. Lester Boyer, Prof. of Architecture, 103 Architecture Bldg., Okla. State Univ., Stillwater OK 74074; **Clearing House for Earth-Covered Bldg.**, School of Architecture, Univ. of Tex. at Arlington, Arlington TX 76019; **Underground Space Center**, 221 Church St. SE, Univ. of Minn., Minneapolis MN 55455.

Periodicals: *Earth Shelter Digest and Energy Report*, WEBCO Publishing, Inc., 479 Fort Rd., St. Paul MN 55102; *Underground Space*, bimonthly journal of the American Underground Space Assn., Dept. of Civil and Mineral Engineering, Univ. of Minn., Minneapolis MN 55455.

Books: *Earth-Sheltered Housing Design*, 300-page compendium by Underground Space Center, \$11 from Center (address above); *Landscaping that Saves Energy Dollars*, by Ruth S. Foster, David McKay Co., Inc., New York, 1978; *Natural Solar Architecture: A Passive Primer*, by David Wright, illus. by Dennis Andrijko, Van Nostrand Reinhold Co., New York, 1978; *Underground Houses: How to Build a Low-Cost Home*, by Robert L. Roy, Sterling Publishing Co., Inc., New York, 1979.

Architectural and engineering firms with standard (and custom) plans for earth-sheltered housing: Solar Earth Energy, Inc., 2020 Brice Rd., Reynoldsburg OH 43068 (also gives seminars); R. D. Strayer, Inc., 5490 Ashford Rd., Dublin OH 43017; U'Bahn Earth Homes, 4008 Braden Ave., Granite City IL 62040 (also seminars). For complete list, consult Underground Space Center's data bank at Univ. of Minn. address above.

PS editor rides advanced magnetic-lift train

By BEN KOCIVAR

HAMBURG, GERMANY

Seated in a two-car magnetic-levitation (maglev) train, I discovered the idea of "flying" on electric current was more exciting than the physical sensations of the ride. That's because the maglev Transrapid 05, carrying thousands of passengers at the six-week transportation show here, provided such a remarkably smooth, almost noiseless ride. As we accelerated along a curved elevated guideway, I could easily hear low levels of sound—from the soft piped-in music to the other riders' relaxed conversations, frequently punctuated with teutonic equivalents of "Wow!"

Transrapid 05, a demonstration vehicle, is the fifth in a series of maglev vehicles built with government support by Kraus-Maffei and Messerschmitt-Bolkow-Blohm. On-board magnets suspend the vehicle by lifting it upward toward electrically magnetized guideway coils. A linear-induction motor, with one of its components also built along the guideway, propels the vehicle. Ultimately, improved Transrapid trains may speed passengers over short-haul lines, or whisk them at speeds up to 250 mph on long-distance routes.

But many adults and children got a realistic taste of future high-speed ground transportation aboard Transrapid 05. Each day of the show, the new German vehicle ran up and down its 2979-foot guideway several times an hour. To schedule thousands of eager riders, numbers from prized tickets were flashed on an electric sign at the station platform.

Each car of the 36-ton train carries 68 passengers. Seating is comfortable and well designed. Huge windows give you a sense of space that's unusual for mass-transit vehicles. The control panel is surprisingly compact: Switches and dials for the levitation, propulsion, and braking functions look less complex than panels I've



Curved research track, built by Thyssen Henschel, is over ½-mile long. Guideway aids train suspension and motion.

Passenger cars for the demonstration vehicle are spacious, with large windows. Electromagnetic train is almost silent.

seen for electric toy trains. Fingertip pressure on the 05's controls move the advanced maglev vehicle to its demonstration speed of 56 mph.

The Transrapid 05 is amazingly quiet from the outside, too. I stood below its elevated track as the train zipped by. As it passed, all I could hear was an aerodynamic swish that sounded like a glider floating past.

Aboard the roomy German vehicle, I was reminded of an earlier maglev ride [PS, Aug. '79] aboard the much smaller HSST (High Speed Surface Transport) under development by Japan Air Lines. This Japanese vehicle seats only seven; it is the research prototype of a larger train that may carry passengers between downtown Tokyo and its airports.

The West German government has already started development of the next practical step in high-speed mag-



Compact control panel for the Transrapid 05 magnetic-levitation vehicle is examined by author Kocivar, in driver's seat.



lev transportation. Eight companies, lead by MBB, have formed the Magnetbahn Transrapid consortium. It will build a 19-mile test track west of Bremen. By 1982, a new vehicle, Transrapid 06, should be operational. This train could carry 200 passengers; it will be 177 feet long, weigh 120 tons, and travel at 186–250 mph.

This is the anticipated size and performance for intercity European maglev trains. In addition to quiet, non-polluting travel, the aim is also to reduce dependence on oil as a primary source of energy.

Supersonic car

rockets to new record



A Sidewinder missile blasts this car through the sound barrier

By JIM SCHEFTER

The bright red tube crouched on the dry lake bed at Edwards Air Force Base, Calif., its three aluminum wheels scarcely denting the desert.

Then driver Stan Barrett, a slender, supple Hollywood stuntman who barely fit into the 20-inch-wide cockpit, hit the start button. Superheated peroxide combined with a solid rocket fuel and the car vaulted forward.

For long moments the car was hidden behind a screen of dust and its own exhaust. Then, far down the lake bed, it outraced the cloud. Now Barrett ignited a second rocket, a Sidewinder missile.

He felt a kick of more than three G's, and then the car rammed through a barrier until recently thought impossible for wheeled vehicles. At 731.9 mph, the rocket car burst through the speed of sound. It accelerated another fraction of a second, topping out on ra-

dar at 739.66 mph. The entire run took 17 seconds.

As the last of the fuel burned away, Barrett was pushed forward against 15 restraining straps with deceleration forces of minus three G. At the same moment, films later showed, the two rear wheels lifted and only the nose wheel kept the rocket car in contact with earth.

It was 7:26 AM on December 17, 1979, with the desert air temperature a frigid 20 degrees F. (The speed of sound at a given altitude varies with the temperature. At 15 degrees F, for example, it's 728.1 mph; at 45 degrees F, 750.7 mph.) On its 18th run, the car designed and built by Bill Fredrick of Chatsworth, Calif., went into the history books.

No novice at building rockets, Fredrick got his start in the 1960's working with Rockwell on rockets and combustion problems. Later he turned to the largest commercial user of rockets in the world—the movie industry—and began making bigger and better rockets to help flip cars in midair. Most of his rockets use hydrogen peroxide—it emits no visible exhaust to betray the secret.

Breaking the speed of sound has been Fredrick's single-minded goal for nearly two years. He faced three distinct problems: aerodynamics, propulsion, and surface friction.

"I wanted it light, narrow, and small," he said. "The shape of the car was critical to control."

The result is a pointed, triwheeled tube 39 feet, two inches long. It narrows to a wedge at the bottom to deflect transonic shock waves. The cockpit is near the rear, just at the base of a nine-ft. tall fin. Most of the tube is a pressurized fuel tank.

Borrowing heavily from recent aerodynamic research, Fredrick tapered and curved the car's nose in a minimum-resistance shape called a Von Karmann/Ogive curve. Another curve, a double tangential Ogive, gives the canopy area the best air flow. The car's total frontal area is less than 11 square feet. Below 450 mph, drag is virtually zero. Only when the car passes 600 mph does aerodynamic drag and rolling resistance of tire against earth begin to mount.

Fredrick settled on a hybrid rocket to blast the car toward its goal. The result was a unique rocket that could

generate about 9000 pounds of thrust with hydrogen peroxide alone. Fredrick developed a catalytic screen—a silver mesh coated with a secret substance he will only identify as based on a rare-earth element—that decomposes the hydrogen peroxide into steam. The engine was used in its monopropellant form during the lower-speed runs early in the program.

For high-speed fuel, Fredrick chose solid polybutadiene rings. Superheated steam from the decomposed hydrogen peroxide in turn decomposes the polybutadiene. Autoignition follows almost instantly, doubling the thrust.

The whole firing sequence is computer-monitored through a sophisticated telemetry system. If anything went wrong during a run, either Barrett or the on-site computer would shut down the engine by stopping the peroxide flow.

To keep the rocket simple, Fredrick avoided pumps and turbines. "With pressurized tanks, you blow it through the motor rather than pumping it," he explained.

Fredrick and his small staff built the car and rocket engine in his backyard shop. With designs for both fairly well along, he concluded that he still lacked enough power to guarantee breaking the sound barrier.

He opted for a simple solution. Some spare Sidewinder missiles were available from the Navy. One missile was

small enough to fit over Fredrick's engine, inside the car body. It was lightweight enough (110 pounds) to give no negative effect on vehicle performance, yet would add 6000 pounds of thrust.

That left the wheels. Aluminum-alloy wheels were manufactured by "upset forging"—a process that batters a billet to flatten it into a circular ring. That gave wheels with a radial grain in the metal, yielding a tensile strength that could resist up to 65,000 pounds of centrifugal force. Fredrick calculated that at 750 mph, the 33-inch front wheel, rotating at 9200 rpm, would experience more than 45,000 pounds of centrifugal force at its hub.

Each wheel has a diamond pattern milled into its surface to give maximum grip. At high speed, the downward pressures on the car push the

Rocket expert Bill Fredrick inspects polybutadiene rings used as solid fuel in his supersonic car. Polybutadiene, a hydrocarbon also used for plastic trash bags, has enormous energy when oxidized by hydrogen peroxide. The combination powers Fredrick's unique rocket that produces 18,000 pounds of thrust.

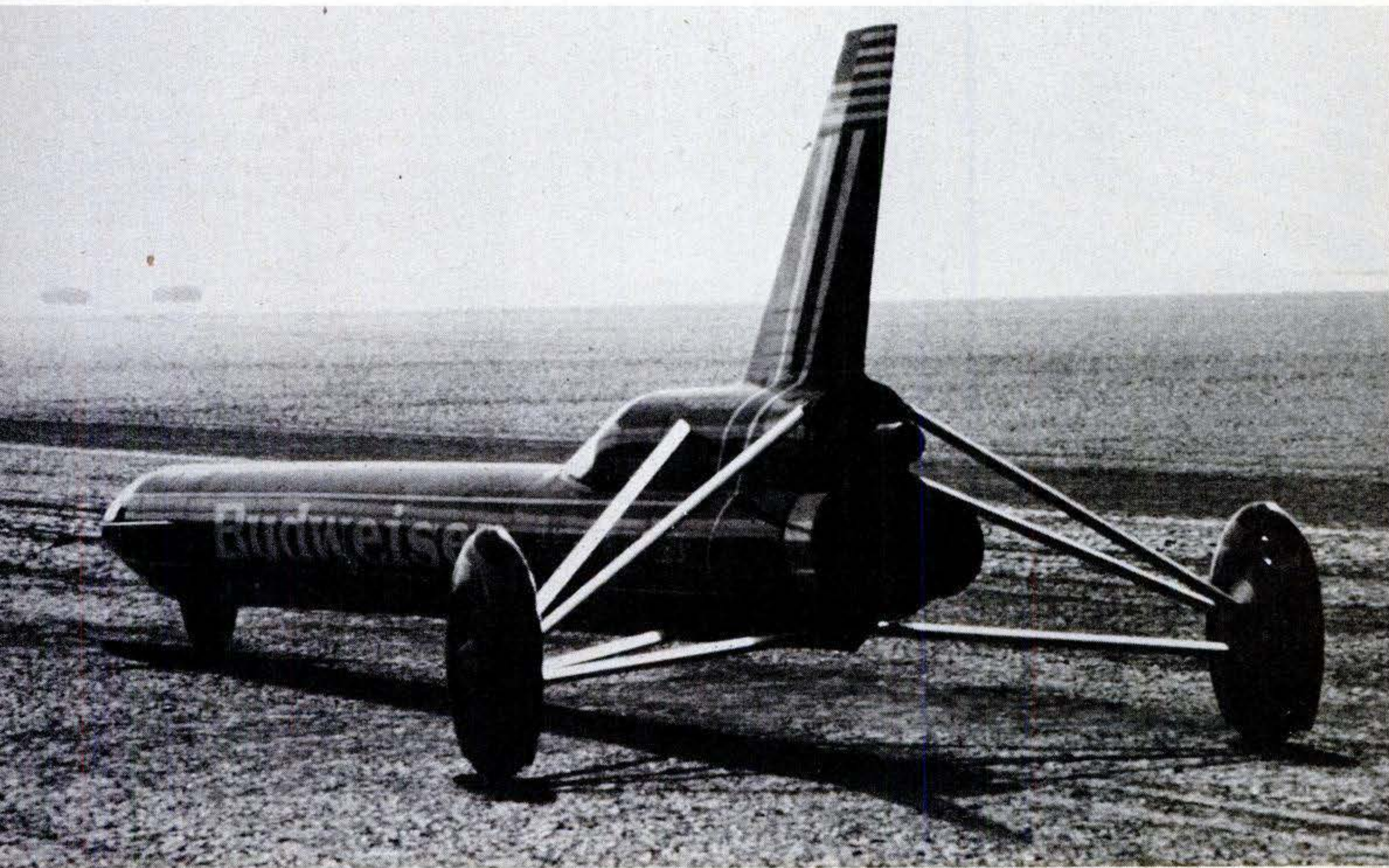
Tall tail fin stabilizes long-nosed rocket car. The "nose" is really a giant, divided fuel tank. Its front four feet, pressurized at 2000 psi, hold solid fuel rings. The eight-ft.-long rear tank, pressurized at 600 psi, holds peroxide.

wheels about ½ inch into the hardened lake bed, enough to guarantee excellent traction.

Everything came together in 1979. Fully loaded—fuel, driver, Sidewinder, and braking parachutes—the rocket car weighed just 5320 pounds. Its empty weight was only 3190 pounds.

Test runs began at Bonneville Salt

[Continued on page 176]



Phone add-ons

that ease
telephone chores



Plug-in attachments
make your phone
a personal secretary

By **LAURA WESSNER**

PHOTOS BY ORLANDO GUERRA

It took a hundred years for Bell Telephone to get nearly everyone on the phone. Now—in just two years—we're overwhelmed with electronic gear designed specifically to get us off.

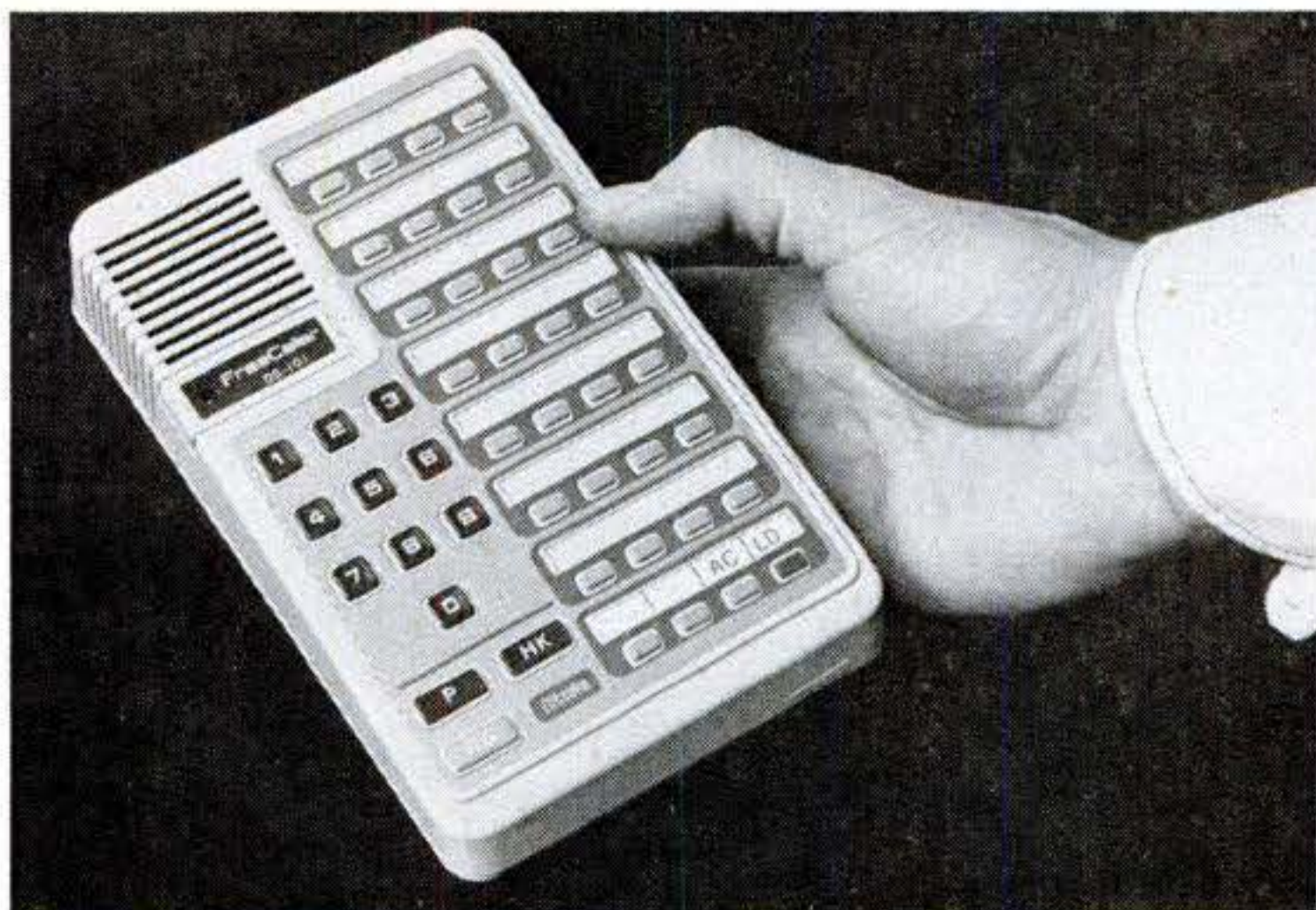
New electronic dialers, for instance, automatically dial any one of several preprogrammed numbers for you—and redial the number if the line is busy. Phone-answering machines are slim, simple to operate, and offer a variety of features. Speaker phones have moved off desk tops to hang on walls for hands-free talking from the kitchen, workshop, or garage. New "computerized" boxes do everything from timing your calls to rerouting them.

And don't discount your phone company. Not only is Bell Telephone in the phone-attachment business (rental only), but your local exchange could be offering custom calling services that can take messages or turn your present phone into an instant dialer. (It's all done electronically at the switching office.)

There are models and brands in abundance (the few shown here are good examples of what's available). You'll find them in most local stores that handle phone accessories. Can you justify spending \$150 for a box that dials a number, or answers the phone for you? For normal home use, perhaps not. But, as I found after getting used to having these around, unplugging them was about as welcome as a bad connection.

For more phone add-ons, turn page

Automatic dialers make your calls



Instant dialing: Push a button, and these clever boxes automatically dial a preprogrammed number or redial a previously busy one. From left to right, top to bottom: The Nitsuko Free-Caller (\$170), for example, stores up to 30 16-digit numbers, has instant redial, and lets you dial manually on a separate keyboard. The Code-A-Phone Memory Phone (\$200) is actually a telephone with a built-in dialer—it completely replaces your present phone. If you need lots of number storage, the Hi-Tek Autotouch models should do; the one shown (\$200) dials up to 40 numbers (there's also a 60-number model). The Heathkit dialer, an \$80 kit you put together in a few hours, stores up to 16 15-

digit numbers. The Otron Computer dialer (\$200) uses a microprocessor. Reason: It's a dialer for up to 20 numbers, an electronic clock with five alarm settings, and a 12-digit calculator. A built-in speaker lets you monitor calls. Tap the "on" button of McDonald Distributor's Hands Free Speakerphone (\$130) and start talking—a built-in mike/speaker allows hands-free operation. A redial button re-calls the last number tried. Push one button on TeleDevices' Modulus Serenader (\$130) and it redials a number; push another and it puts the caller on hold—and plays music over the line. Finally, if you don't want to buy, you can rent Bell's Touchmatic 16-number dialer/phone for \$9 a month.

Automatic answerers take your messages



Phone-answering machines electronically "lift" your phone when it rings. An outgoing message greets the caller and the incoming message is recorded after the "beep." But that's just the beginning (left to right, top to bottom): You can use the Record a Call 80AT (\$300) as a dictation

machine, to tape both sides of a conversation, or to record up to 120 messages. The Ford Code-A-Phone 333 (\$550) can be run by remote control with the pocket beeper. The Tele-Tender 37 works remotely, too, but uses conventional Bell Tel Touch Tone signals for control. (Beep-

er is needed on phones without Touch Tone.) Price: \$169. Phone Mate 930 (\$300) uses a microprocessor for additional mechanical control, such as remote-controlled backspace to replay a particular message. Answerex A-100 (\$100) uses a single cassette for greeting and message.



Gimix Auto-Page (\$250) is an add-on to a phone-answering machine. If the caller hangs on, this box calls another number (paging service) to get you to a phone.

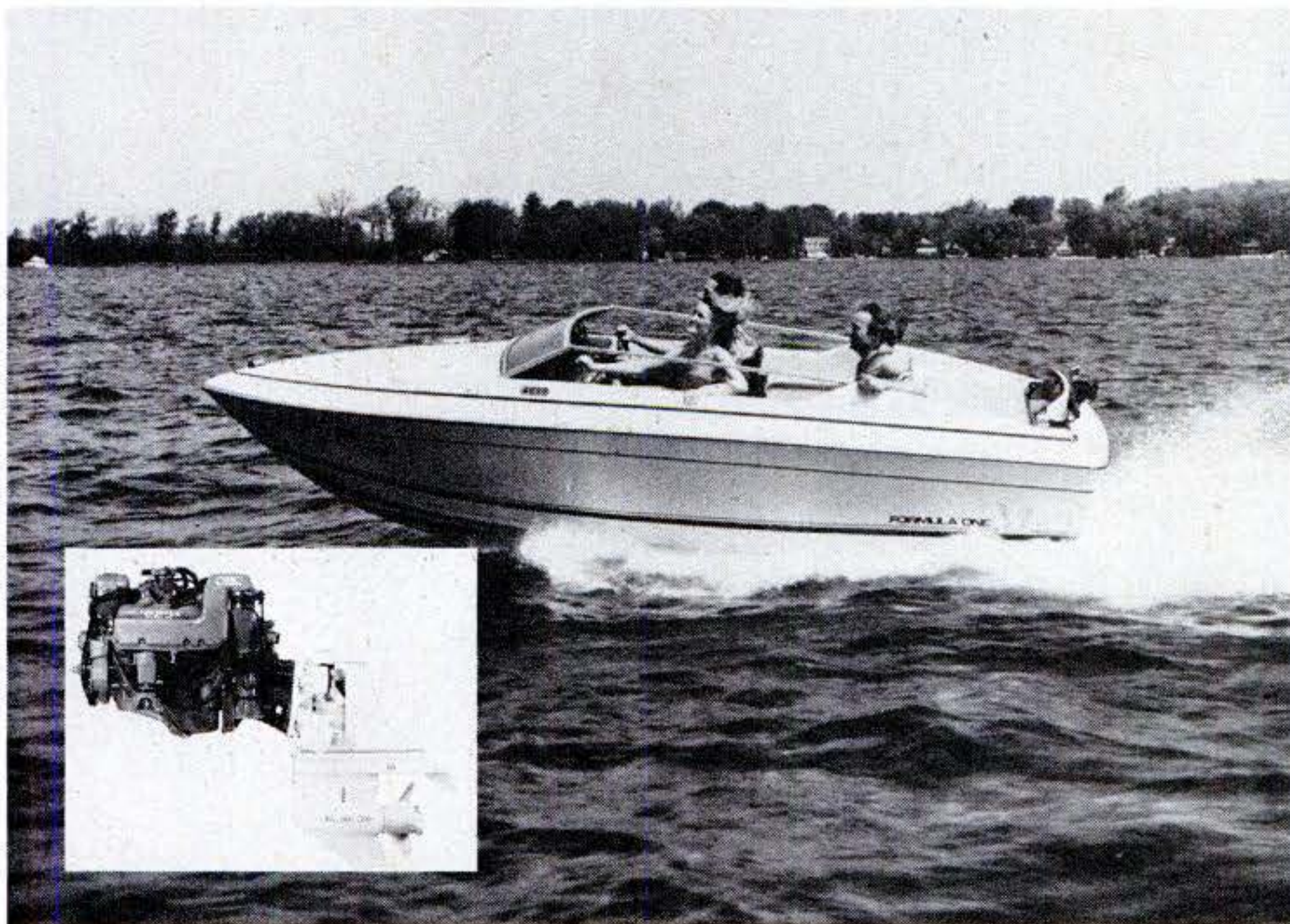


Universal Intelli-phone (\$200) has a built-in clock, timer, alarm, auto dialer (12 numbers plus emergency), hold button, and is self-redialing on busy signals.



Electronic ringer in this Speakerphone 1000 (\$80) from TT Systems signals there's a call; push a button and it gives you hands-free communication.

Fuel-easy, high-performance compact V6 stern-drive



An unusual combination:
spectacular performance
with a small, lean engine

By DAVID D. VIGREN

NAPLES, FLA.

My turn. I slipped into the driver's seat of the Formula I, where for the past 15 minutes Ralph Lambrecht, OMC engineer, had been showing me all the delightful ways to get from

here to there: zooming out of the water and onto plane as we might towing a water skier, dodging the markers, and back again at a purring cruise.

It was all too smooth. Let's try for jolts, I thought. "Hold on," I muttered, and shoved the throttle full forward, stopped dead, full reverse, opened it up in tight turns, tried to torture it. No barking, no roar from the fully charged engine. The peaceful natural scene around us didn't fall squawking apart as it would years ago when I test-drove the last all-new stern-

drive. And I didn't have to play the throttle to extract my demands on this engine.

The new OMC 90° V6 is the first completely different IO to appear in many years. It runs as smoothly as a V8; from feel and sound I couldn't tell it wasn't a V8. Chevrolet engineers found in building the engine that a slightly uneven firing order resulted in the lowest vibration.

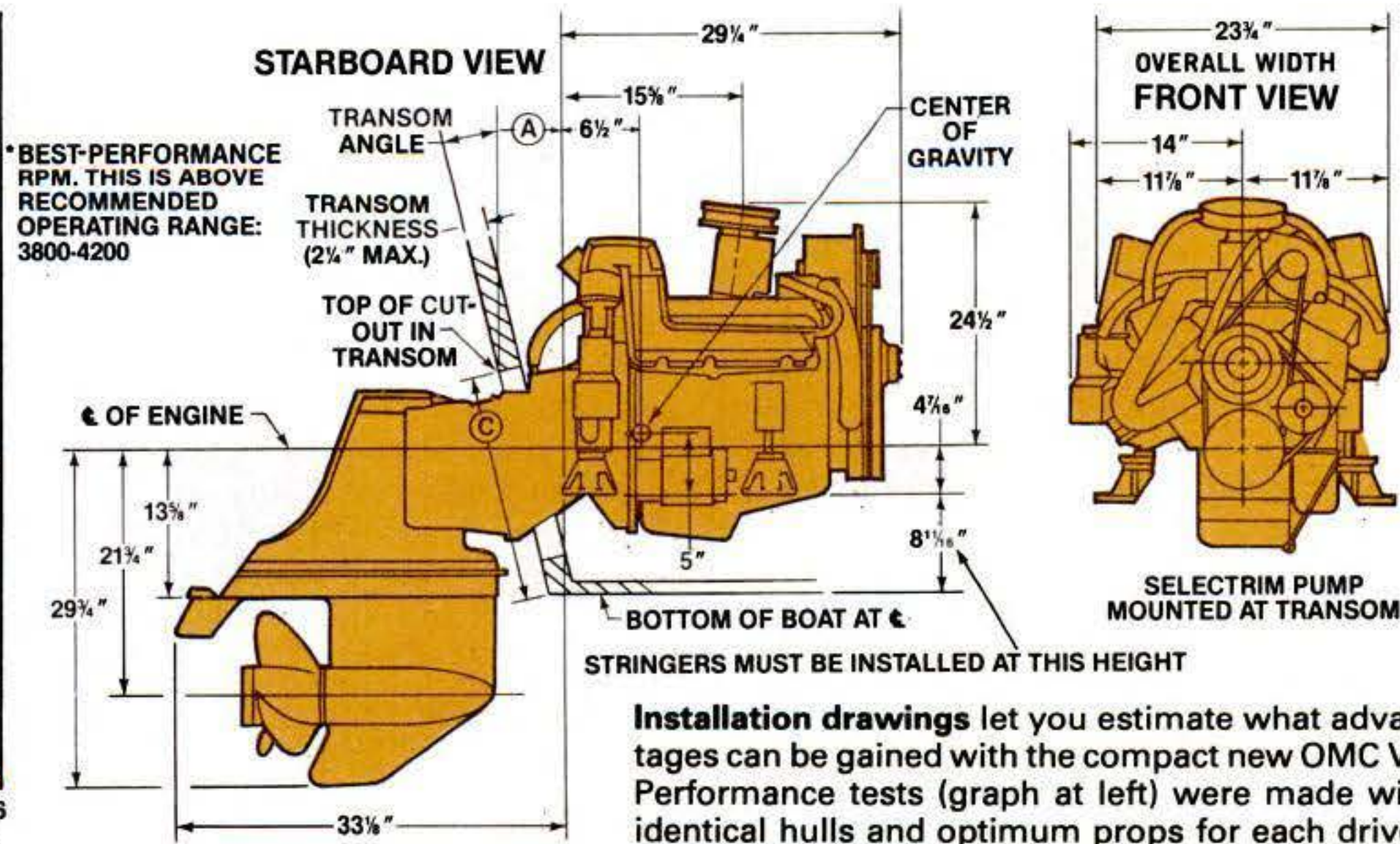
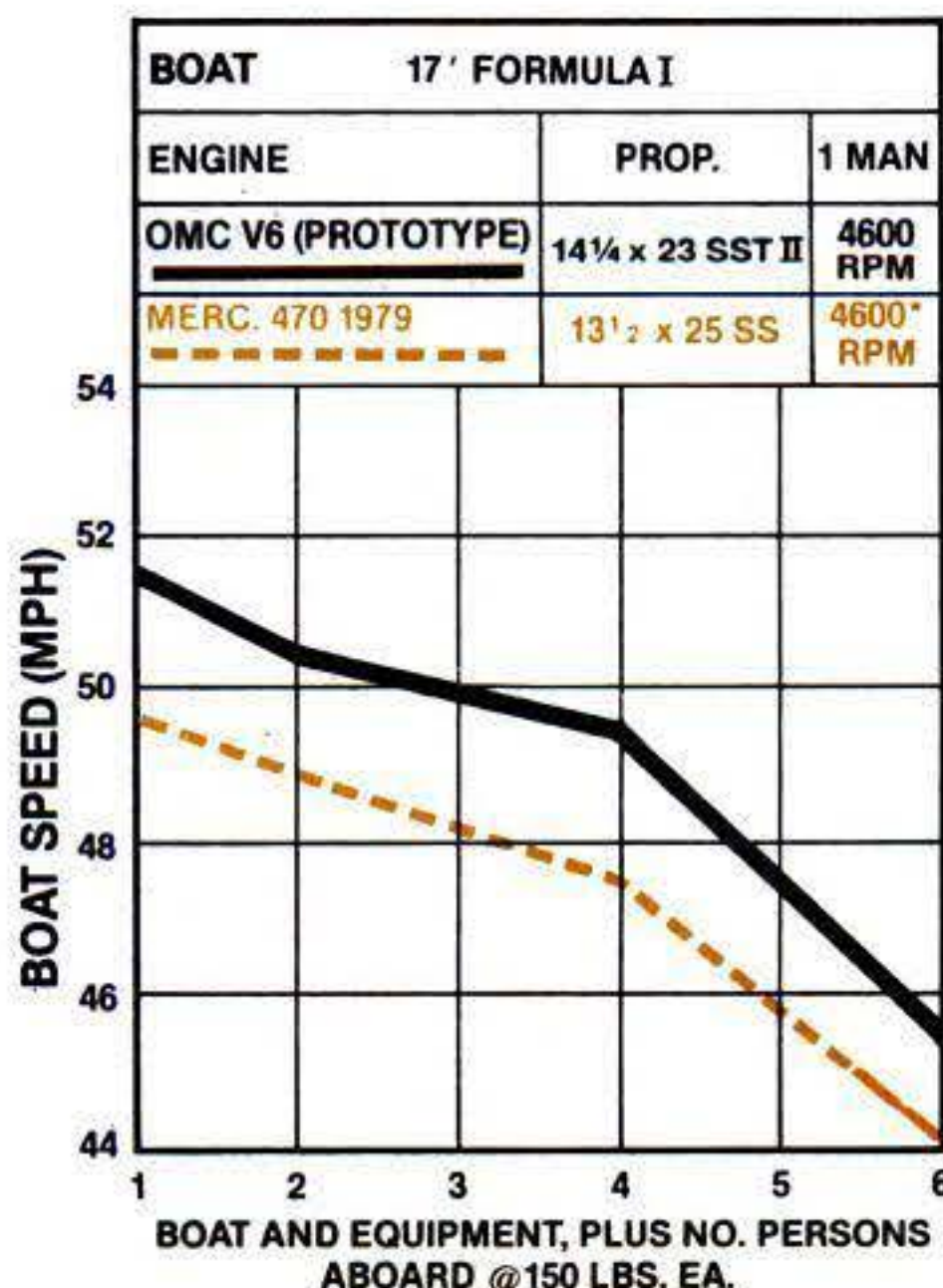
The machine fills a void in marine engine lines that has been lamented since the last V6 block was discontinued in 1972. Its compact size, economy, and performance were ideal for marine use. When the fuel emergency restored the V6, OMC found what it needed in the new 229-cu.-in. Chevrolet engine introduced in the 1980 Caprice. "A new intake manifold and camshaft were developed for the marine version of the engine, which boosted its horsepower output considerably," Lambrecht says. "With block, cylinder head, and manifolds of cast alloy iron, the engine does not require a closed cooling system to protect it from galvanic corrosion. This means long engine life, with raw-water cooling and the collateral simplicity of its cooling-system design."

In addition to restoring a V6 to its line—the only V6 marine engine presently available—OMC is targeting at the Mercruiser 470, a four-in-line, as the one to beat: acknowledgment of the excellent power/weight/fuel consumption/size characteristics of Merc's popular machine. How do they seem to compare?

A matched test

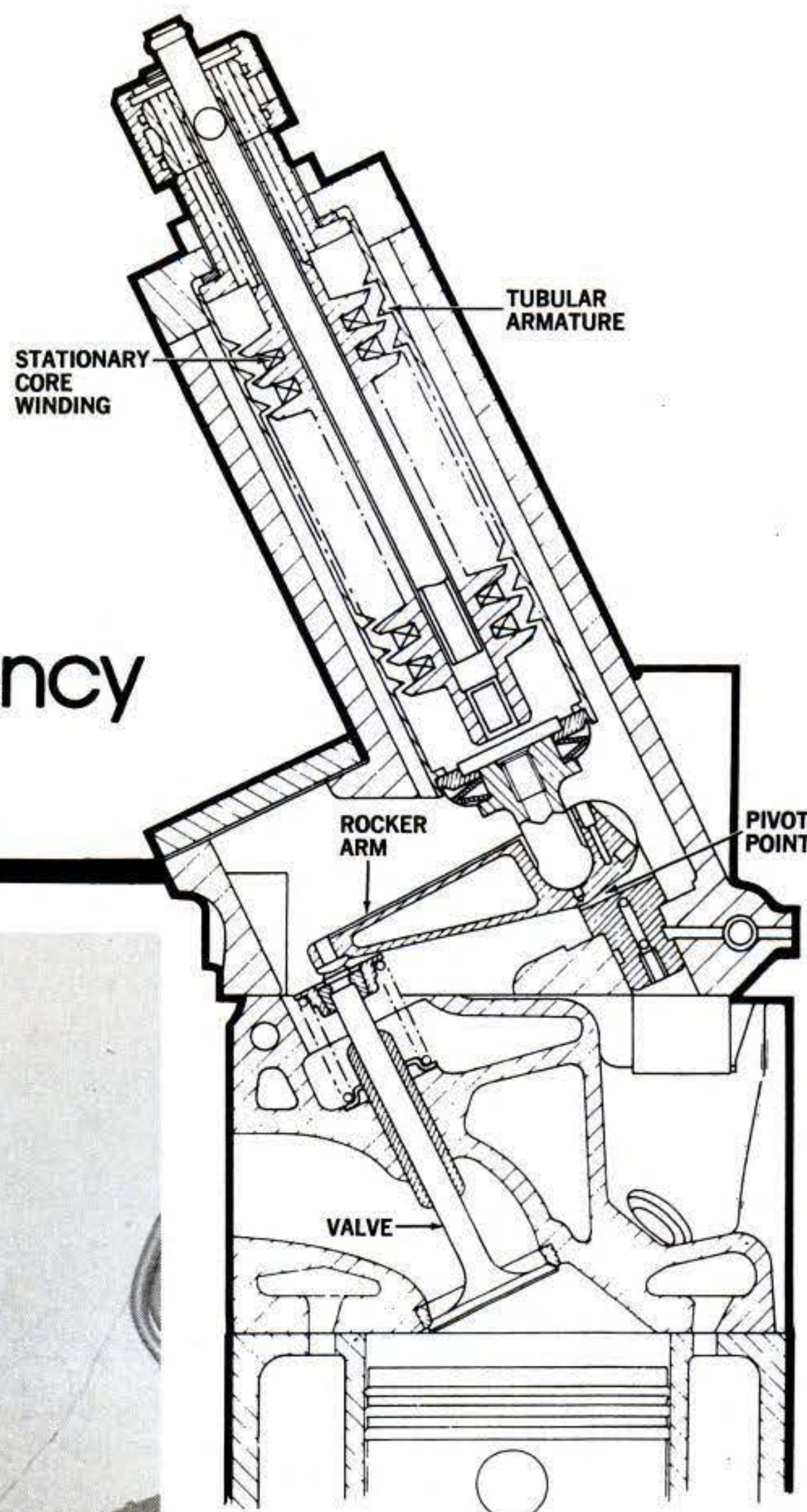
For our tests here, OMC outfitted two identical hulls, one with its V6 engine, drive, and controls; the other with the Mercruiser 470 and Merc controls. Project engineer Dick Wlezien selected propellers for optimum

[\[Continued on page 179\]](#)

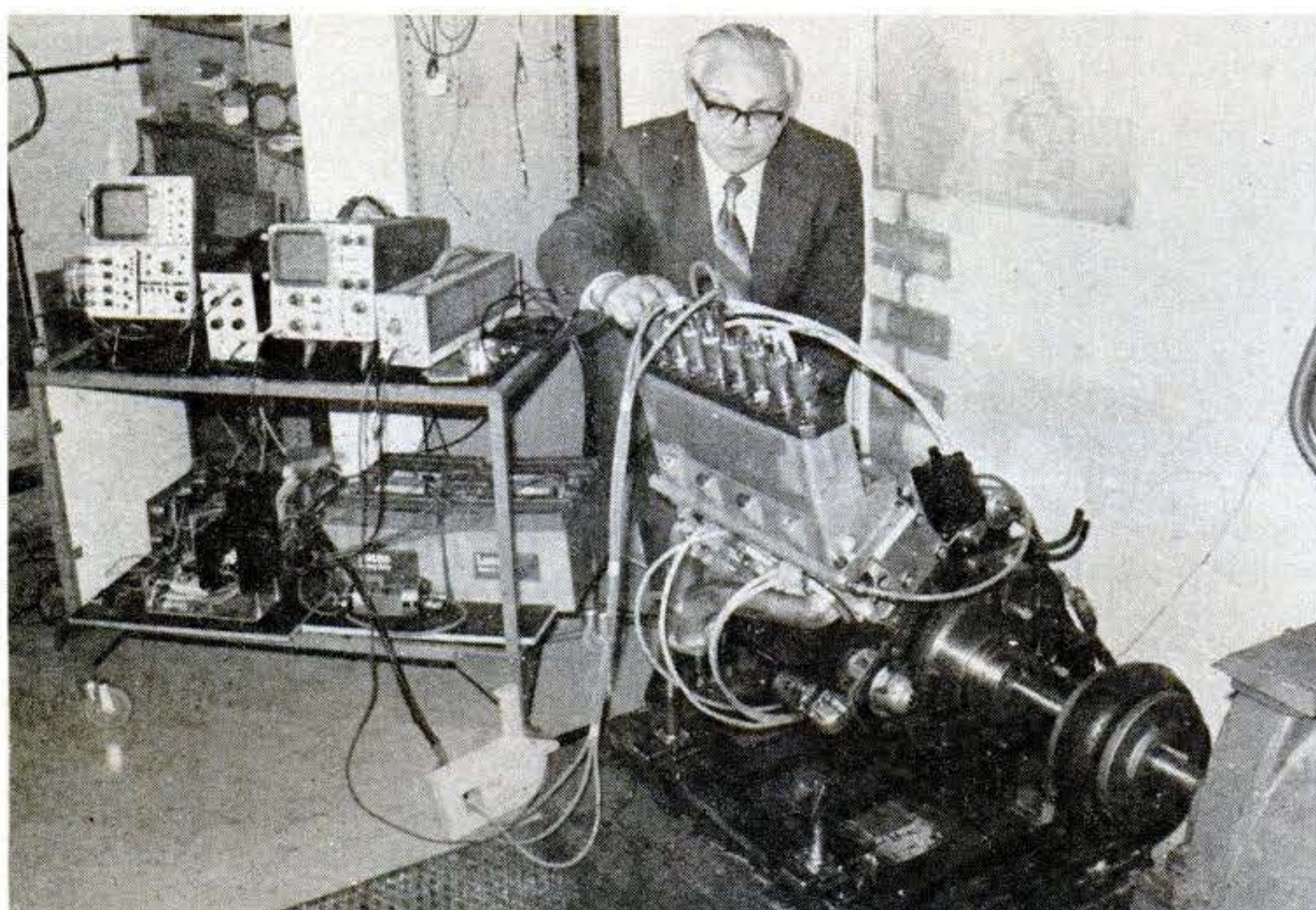


Variable valve timing

to boost engine efficiency



Helenoid installation in a cylinder head is shown in drawing. When the winding of the stationary core is energized, the tubular armature snaps down with a one-mm stroke against the rocker arm. The lever action of the rocker gives the valve a normal eight-mm opening. Cooling water flows through the hollow magnet core.



Engineer Seilly inspects Helenoids on a four-cylinder Triumph engine at SGRD lab.

Electronically controlled Helenoids open and close valves for precise timing

By DAVID SCOTT

Electronics is gradually taking over all the critical mechanical linkages in an engine: Start your car and an electronic ignition gives consistently fat sparks for smooth-running performance with contact points that never need adjusting or replacement; an electronic fuel injection system precisely matches gasoline delivery to requirements for reduced consumption and low emissions.

What next? It could be electronic valve operation, which would complete the electronic takeover of the combustion cycle. Timing could be in-

stantly changed while the engine is running, to ease cold starts, increase low-speed torque, and improve combustion efficiency and fuel economy at all speeds.

To do it, the usual camshaft/valve linkage would be replaced by a group of electromagnetic actuators called Helenoids. Developed by SGRD, a Lucas Industries research company, they are helically wound solenoids capable of applying an extremely high force through a short distance very rapidly. They can be triggered at any point in the engine cycle, so valve opening and closing is not rigidly tied to crankshaft rotation and the conventional timing belt or chain.

With Helenoids, the valves snap open and shut in four milliseconds—an eye blink attainable by a camshaft only when the engine winds up to

about 6000 rpm. Here it's constant throughout the rev range. Result: deeper breathing and better combustion at low speeds.

Such near-instantaneous operation of each unit is controlled by a special electronic distributor with transistor switching. It is regulated by a microprocessor system with inputs from sensors responding to engine and road speeds, throttle opening, coolant temperature, and other parameters. Thus, valve timing is varied with actual loads put on the engine while you're driving.

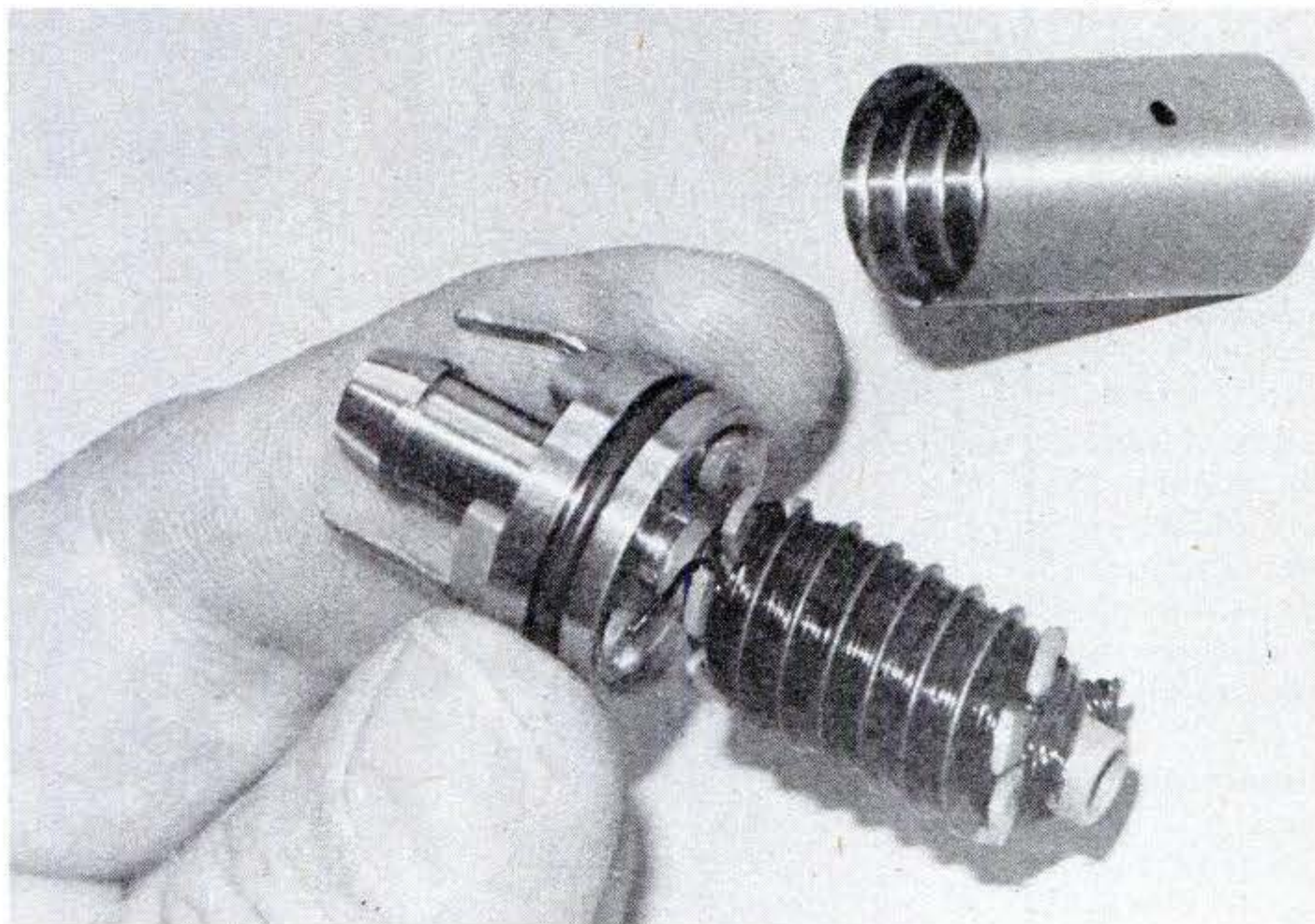
How Helenoids work

It was known early on that conventional solenoids wouldn't work. They are no more than an electromagnet with wire wound around a laminated-steel core. A moving armature plate or



Helenoid above applies a half-ton force with one-mm stroke in four milliseconds. Featherweight armature is a thin tube.

Helenoid below is just 24 mm long, but packs five-kg force. These could be used on valves with lower spring tensions.



block is pulled toward the core pole faces when the coil is energized. The problem is that the applied force can be raised only by increasing the pole-face area. This in turn must be matched by a larger armature, so its operating speed is sharply reduced. To compress a stiff valve spring, a solenoid would be too large and too slow to do the job.

Helenoids are radically different. They're of spiral construction with two coaxial steel cylinders. The stationary inner tube is the core, and it has external screwlike threads wound with the magnet wire. These mate like a loose-fitting nut and bolt with internal threads on the outer cylinder, which is the armature.

The helical design provides a very large pole-face area relative to the armature mass. This moving part can be

extremely light, with the possibility of tube walls a mere one mm thick because they're stiffened by the internal threads. Full magnetic force is concentrated on a featherweight armature, so its speed is phenomenal. Compactness is another big plus.

A further tricky bit is the winding. Both inner and outer spirals have interleaved threads. The fixed inner core is wound so each conducting loop of wire initially passes along the first thread route, then doubles back via the second. Current therefore flows in opposite directions in adjacent helical grooves, resulting in very short magnetic circuits between the core and armature pole faces. This greatly reduces the amount of steel needed for a given thrust rating.

Armature travel is only one mm, so for engine applications this is levered

up by a rocker arm for the normal eight-mm valve lift. SGRD's first laboratory trials are with a Triumph TR7 two-liter four-cylinder engine. Individual Helenoids for the eight valves replace the standard overhead camshaft.

Because of the heat generated in the magnet windings, Helenoids need special cooling. In the test-bed rig, water from an external tank is pumped through the hollow cores. The cylindrical actuators are 170 mm long and 48 mm in diameter, and each is rated at 400 watts.

Peak starting current is a hefty 150 amps because of the tremendous energy required to move the valve in four milliseconds. But after the initial surge, the current drops to only 10 amps while the valve is held open.

Future possibilities

At this stage, SGRD sees Helenoids only as a laboratory aid for engine designers. Fitted to a prototype engine, they will be used to bypass involved theoretical calculations to determine the best cam profiles for performance and emissions, and eliminate costly machining of experimental camshafts for hit-or-miss trials. They're still too complex and expensive to replace any mass-produced camshaft. But future development of cheaper versions could make them a reasonable alternative. Even a higher initial cost could be outweighed by substantial performance gains over camshafts, which, at best, are always a compromise between optimum valve timing at low and high speeds under different load conditions.

"This is a purely experimental set-up at a very early development stage," research engineer Alec Seilly explains. "We haven't yet tested the system properly, so it's too soon to report any results. But already we feel it shows great promise."

Helenoids for future car engines are some years ahead, and there are still plenty of "ifs" and "buts." Right now, cost is the biggest snag, though mass-production techniques might eventually drop that to an acceptable level, Seilly figures. "Smaller actuators running on 12 volts would be suitable for new types of lightweight valves which could operate with lower spring tensions," he says. "Cooling needs would then be smaller, and could be simplified by combining the system with the engine water circuit."

Electronic valve control could be the next step in the ongoing train of engine refinements, where fuel saving and low emissions are often more important than primary cost. This balance should tip slowly toward variable valve timing as oil prices rise. **P5**

Dashboard symbols

— new sign language for car controls

By KATHLEEN MURPHY LORD

You're driving through the Italian countryside, enjoying a long-awaited first visit to the continent, when your rental car stalls and a red light on the dashboard flashes on. You immediately look at the label under the light for the message, only to find that it's in unintelligible Italian. "Benzina" means nothing to you, so a few panic-filled moments pass before you notice the gas gauge is reading empty.

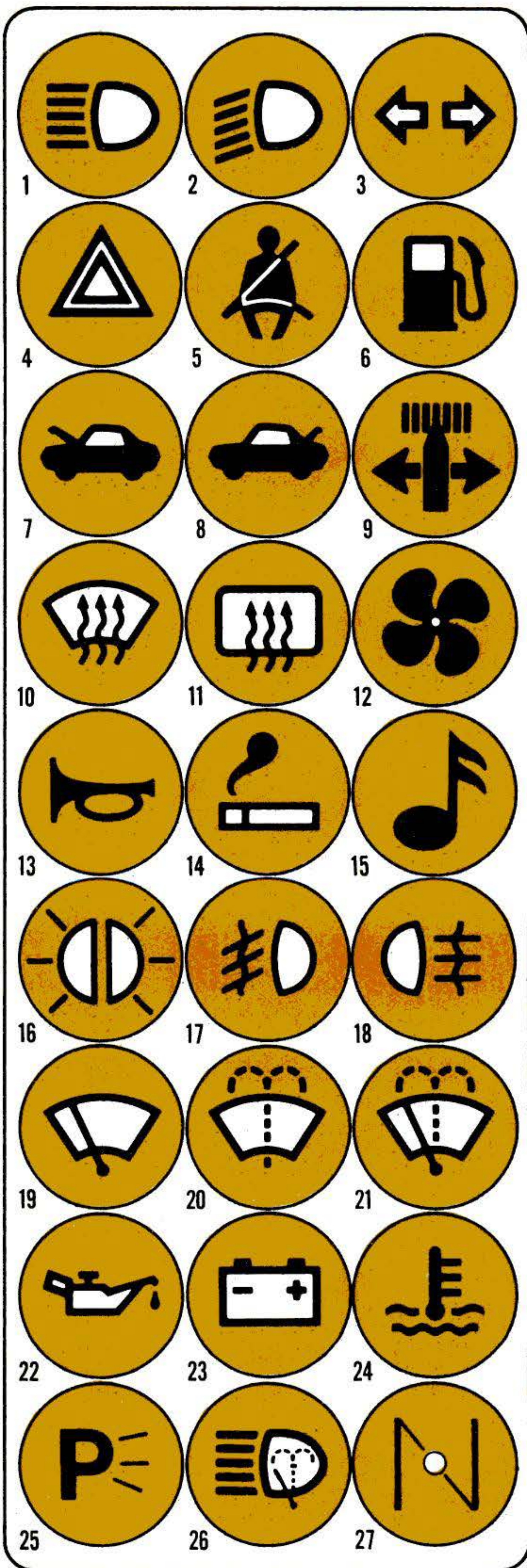
Soon easy-to-understand wordless dashboard symbols will eliminate such problems. The symbols will be the same in cars made in any country, so foreign-car dashboards should be as easy to read as those in Detroit-built vehicles.

Of the 27 symbols pictured at right, 15 will be mandatory on 1981 American cars, while the rest will be optional with the manufacturers. (Those required are numbers 2, 3-6, 10-12, 16, and 19-24.) Some foreign car builders are already using many of the symbols. Detroit manufacturers have also begun using a variety of them on their vehicles—in particular, the new General Motors' X-body cars [see the test report in PS, July '79], which meet the 1981 standards for dashboard display.

All of the symbols have been approved for international use by the International Standards Organization (ISO), the same association that designed the "wordless" road signs now used on highways throughout the world. Not all of the dashboard symbols, however, are newly developed; two have been displayed in GM cars since the early '70's. These are the symbols for radio volume (15) and station selection (9), first seen in the 1970 Chevrolet Vega.

The idea of using symbols really blossomed when the "world-car" concept evolved and was implemented throughout Europe, Asia, Africa, and North and South America with the building of cars like the Chevette. The big car builders hope to continue this internationalization of the automotive industry, and these new dashboard symbols should bring them one step closer to that goal. ■

Sign language for your dashboard: The new picture symbols are easy to read and understand. From top left, they are: (1) high-beam indicator; (2) headlamp switch; (3) directional signal; (4) hazard warning flasher; (5) seat belt; (6) fuel; (7) front hood; (8) rear hood; (9) radio selector; (10) windshield defogger; (11) rear defogger; (12) ventilating fan; (13) horn; (14) cigarette lighter; (15) radio volume; (16) clearance lights; (17) front fog light; (18) rear fog light; (19) windshield wiper; (20) windshield washer; (21) windshield wiper and washer; (22) oil; (23) battery-charge condition; (24) engine-coolant temperature; (25) parking lights; (26) headlight cleaner; (27) choke.



Fiber optics

start a revolution
in our telephone systems
as threads of light
replace copper wires

Ultraclear glass fibers carrying digital pulses spur an information explosion

By JOHN FREE

ILLUSTRATIONS BY ROBERT RITTER

HOLMDEL, N. J.

Jack Cook, the head of Bell Laboratories' Lightwave Technology and Applications Dept., handed me a section of half-inch-thick telephone cable. Instead of copper wire in its hollow core, there were 12 plastic ribbons. Peering closely, I could see what made this so-called light-guide cable so radically different from its predecessors.

Each ribbon contained a dozen hair-thin optical fibers made from ultraclear glass. One of these finger-thick, 144-fiber cables, carrying phone calls as light pulses instead of electrical signals, could handle some 50,000 simultaneous conversations—equivalent in capacity to 4½ wrist-thick cables with 4050 pairs of copper wire.

In Washington, D.C., that same day, AT&T announced an extraordinary use for its new light-guide cable: By 1984, it plans to complete a 611-mile optical-fiber link from Boston to Washington, D. C. The first leg, from New York to the nation's capital, should be complete in 1983.

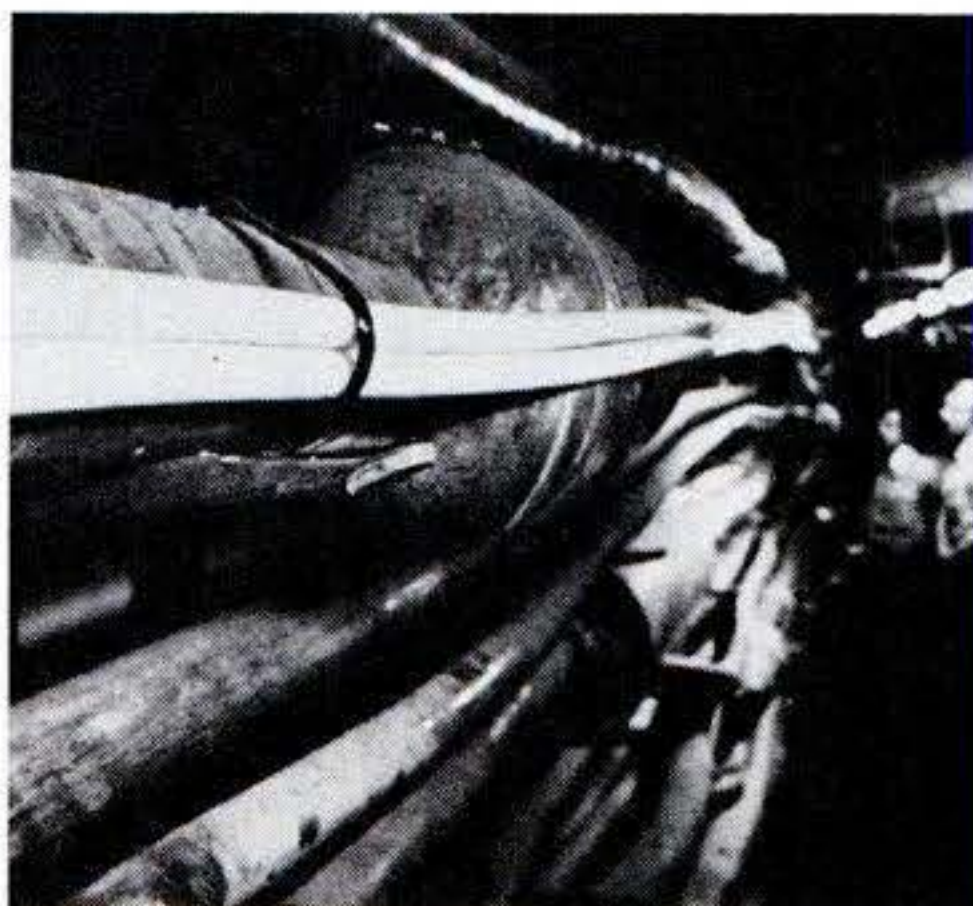
The Bell System's \$79 million Northeast-corridor light-guide system will go into service at a time when worldwide use of optical-fiber communication systems will be expanding rapidly. The demand for hardware, less than \$40 million a few years ago, should rise to over \$500 million by 1983, and may soar to \$2 billion by 1990.

In addition to telephone systems,

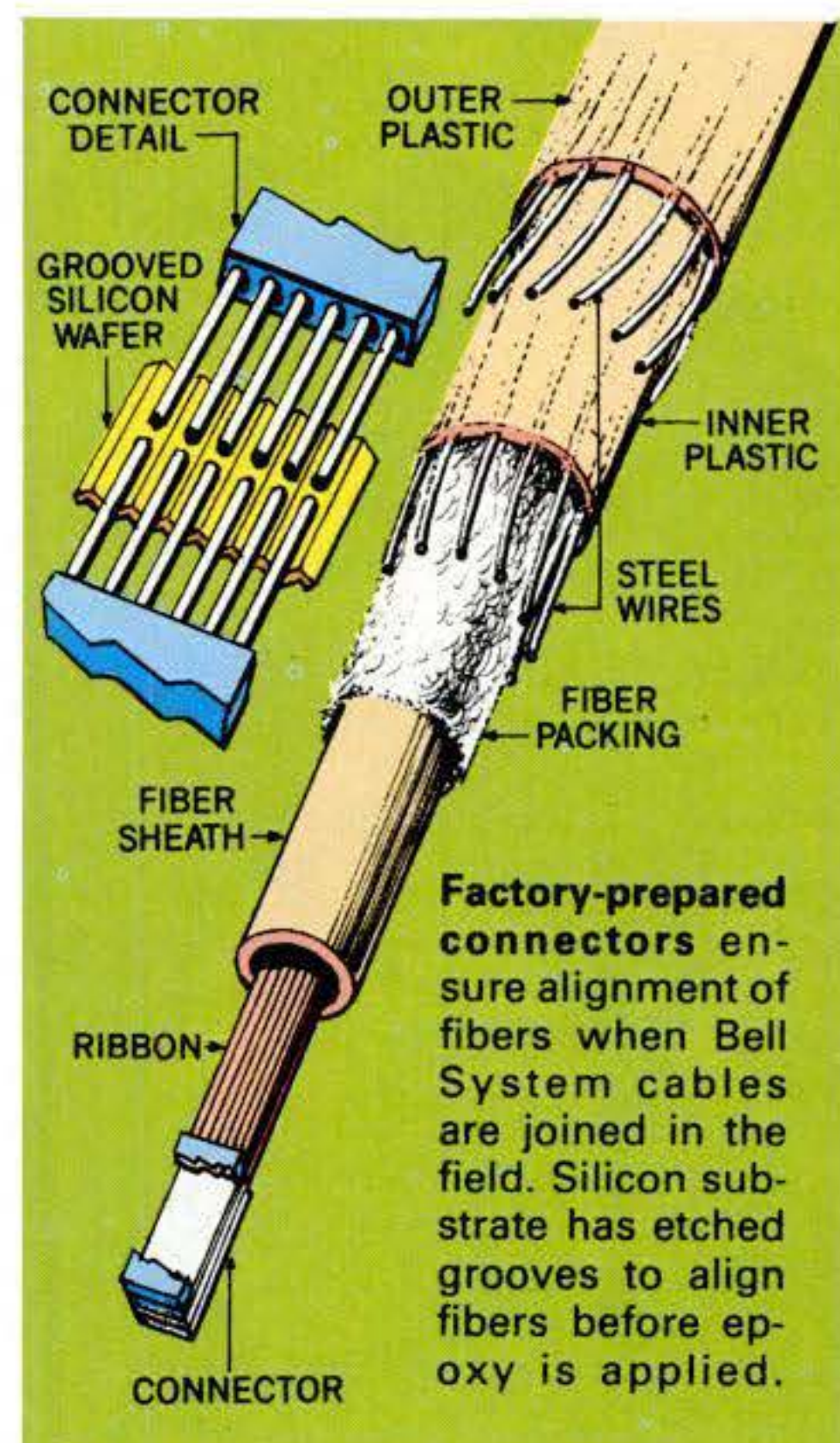
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Glass fibers carried digital voice and analog TV signals at Winter Olympic Games in Lake Placid, N.Y. Before the Games, Bell System engineers tested installation.



Half-inch light-guide cables beneath Chicago's streets connect Illinois Bell central offices in Loop area. Cable run did not require repeaters, unlike copper cables.

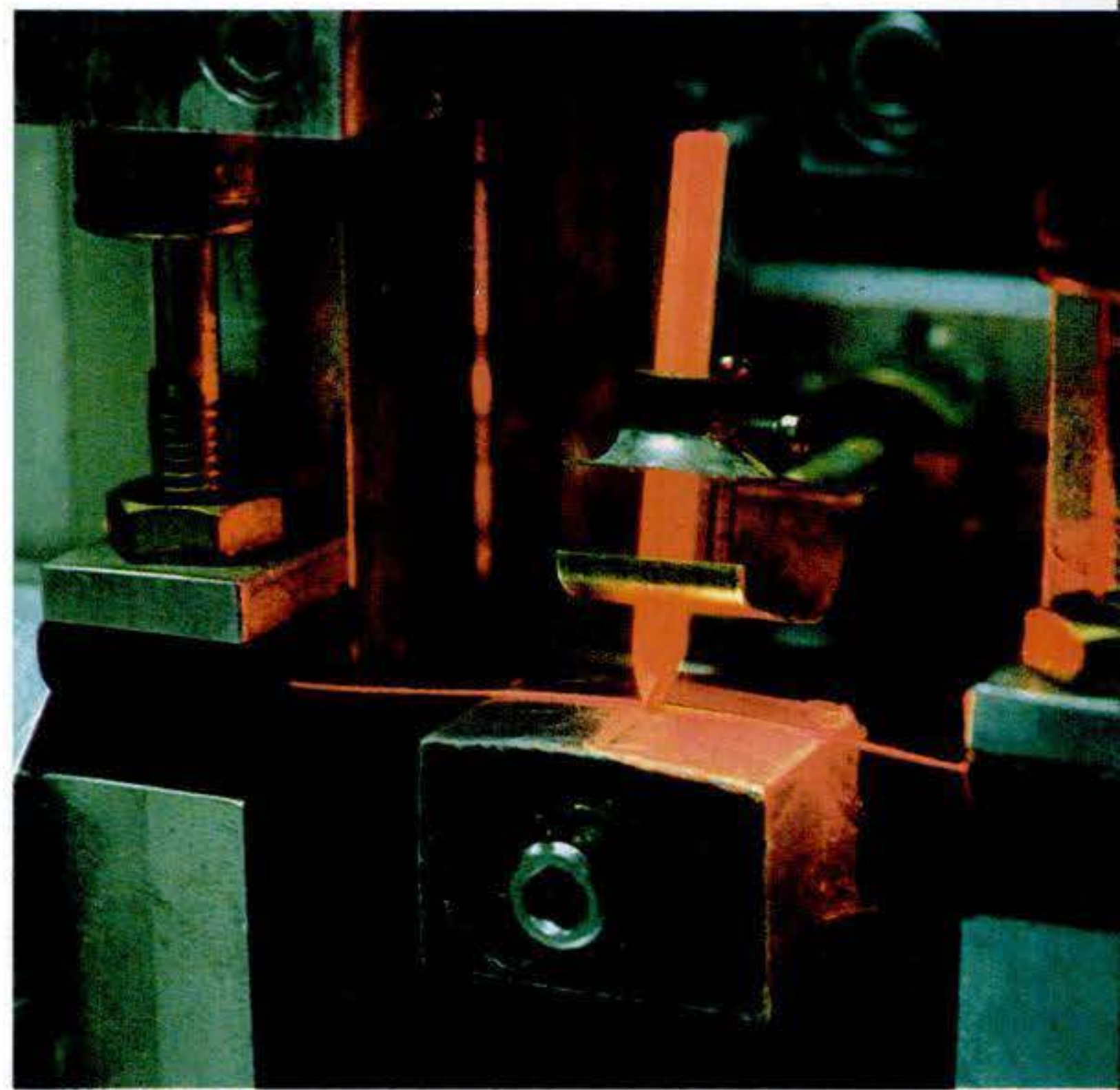


Video-telephone service, using home TV, is only one feature of "wired city" optical-fiber system in Japan (see text). Control on table is used to select services.



Multiburner torch moves back and forth along silica-glass tube. Gases flowing through tube form glass layers with different refraction properties. Tube is then heated and collapsed to a solid rod from which manufacturers can draw hair-thin fibers.

Sapphire stylus cuts through an optical fiber at Corning's quality-control lab. As fiber is scored and cut, light that is normally reflected internally along the fiber scatters up through the sapphire. Fibers have a protective plastic coating.



Solid-state laser (lower right), a speck no larger than a grain of salt, beams a narrow, intense beam of light on pin at RCA Labs. Tiny devices now can operate for over one million hours.

Laser light illuminates a drum with three kilometers of Corning's optical fiber. Light is actually "leaking" from core of fiber. Unattainable perfect fiber would channel all light through it.

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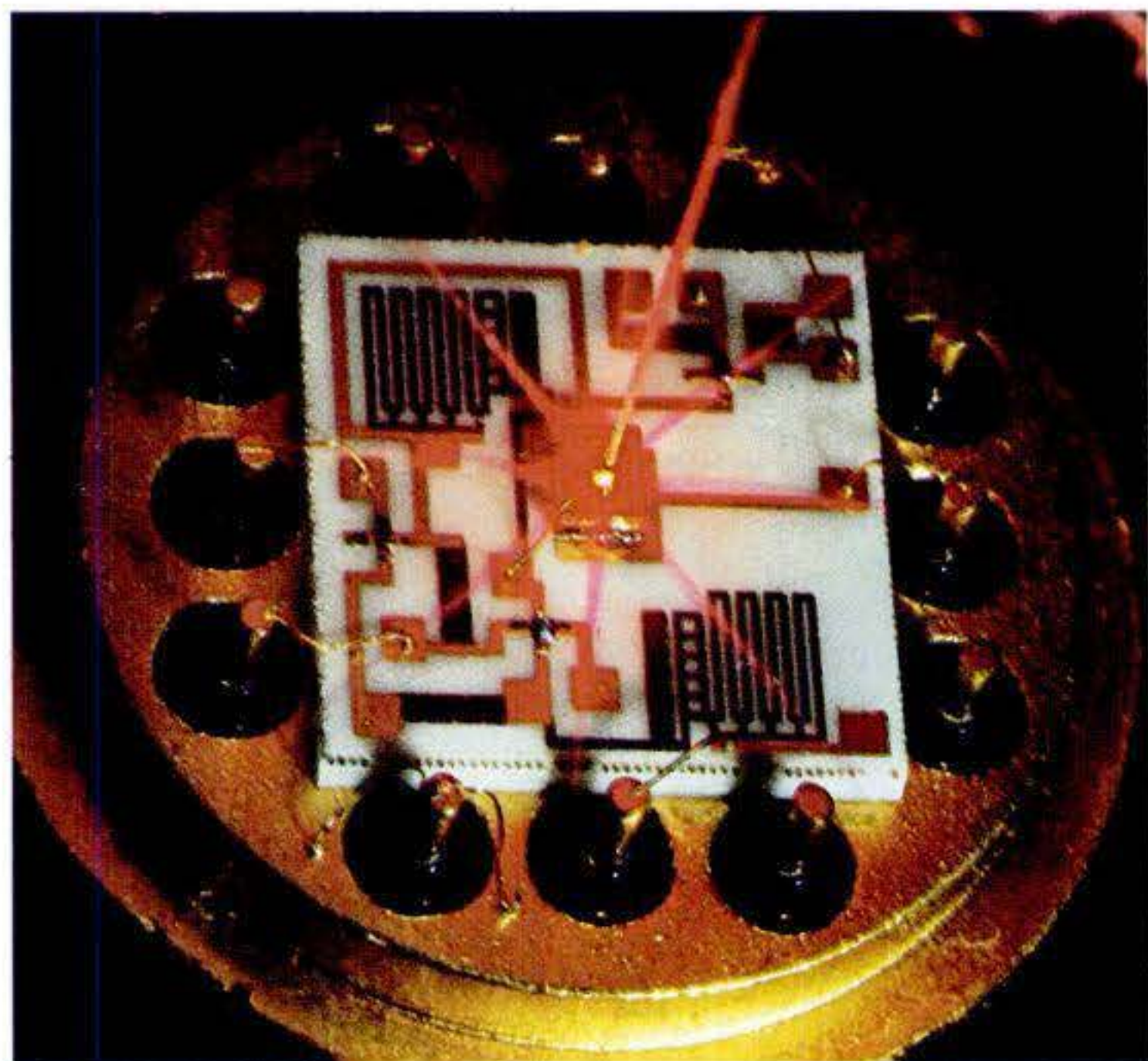
uses include: cable TV, piping data between computers and peripheral equipment, including on-board car microcomputers [PS, Aug. '79], and industrial cabling. The peculiar ability of fibers to channel light waves promises more conventional uses, too: instruments with eyepieces to permit

inspection of inaccessible areas during assembly or maintenance of products; similar medical hardware to peer into the body; detection of light-bulb failure (in cars); funneling light from one source to many points.

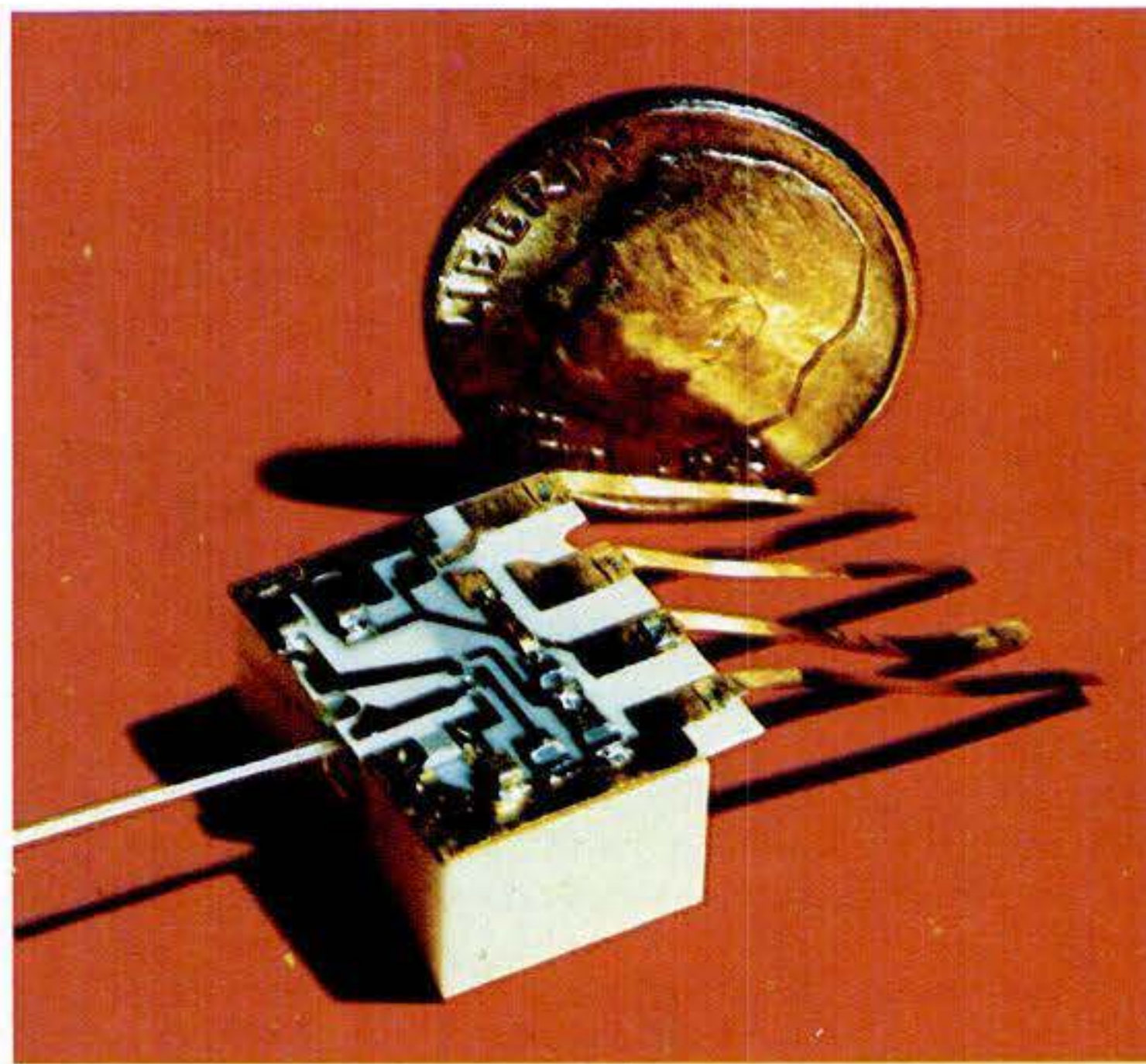
When I visited Bell Labs five years ago ["Coming Age of Fiber Optics,"

PS, Aug. '75], researchers were tackling technical problems to make optical-fiber telecommunications economically feasible. "The big improvement since that time is that we've reduced the technology to a manufacturable state," Cook explained.

Continued

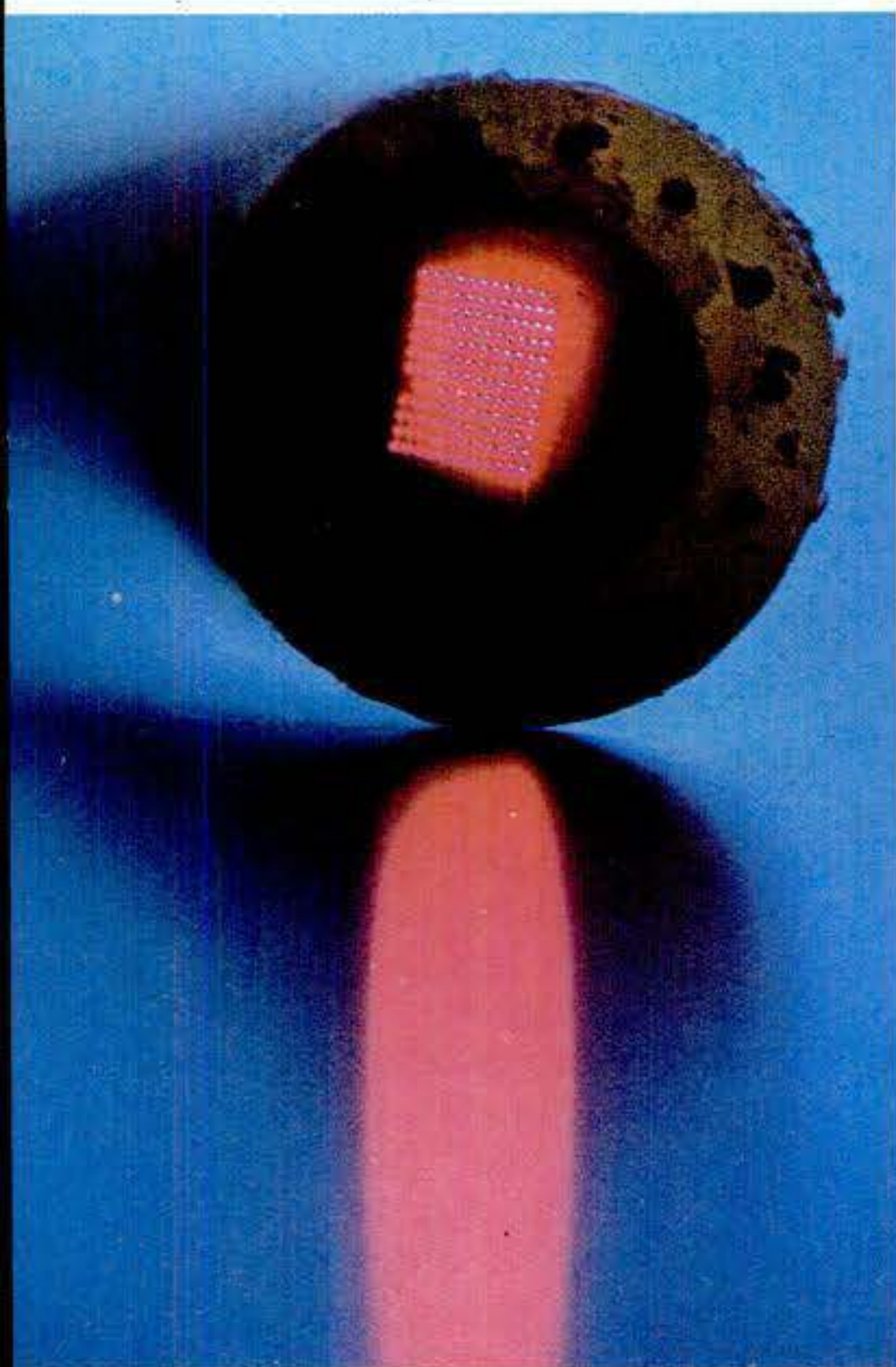


Burst of light is beamed through fiber connected to Bell Labs photodetector that converts light into electricity. Detectors can sense light reduced to billionths of a watt by fiber attenuation.

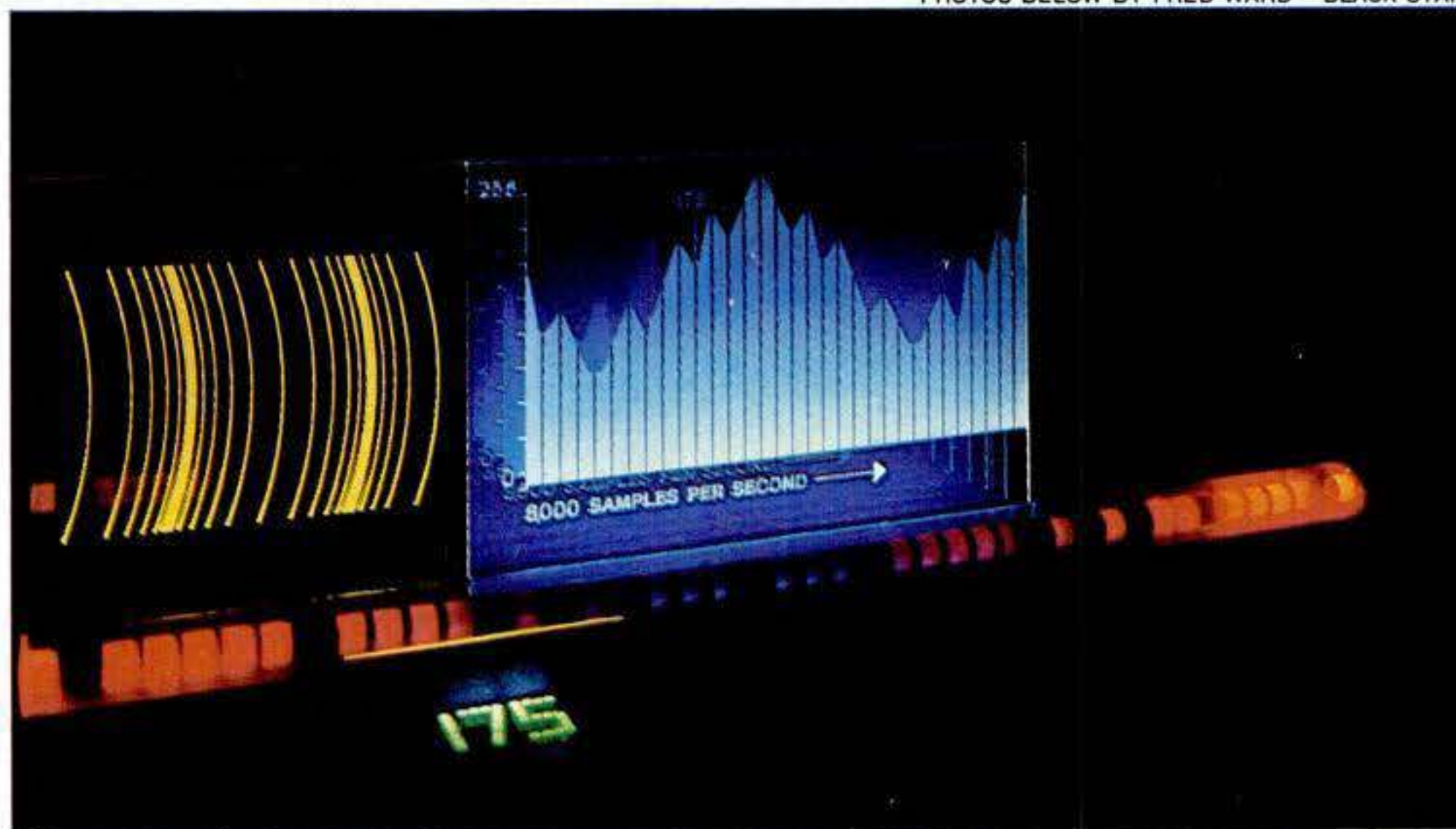


Laser-transmitter module developed at RCA Labs beams light through fiber (left) attached to it. Fiber is single-mode type that allows only a single ray of light through its core.

PHOTOS BELOW BY FRED WARD—BLACK STAR

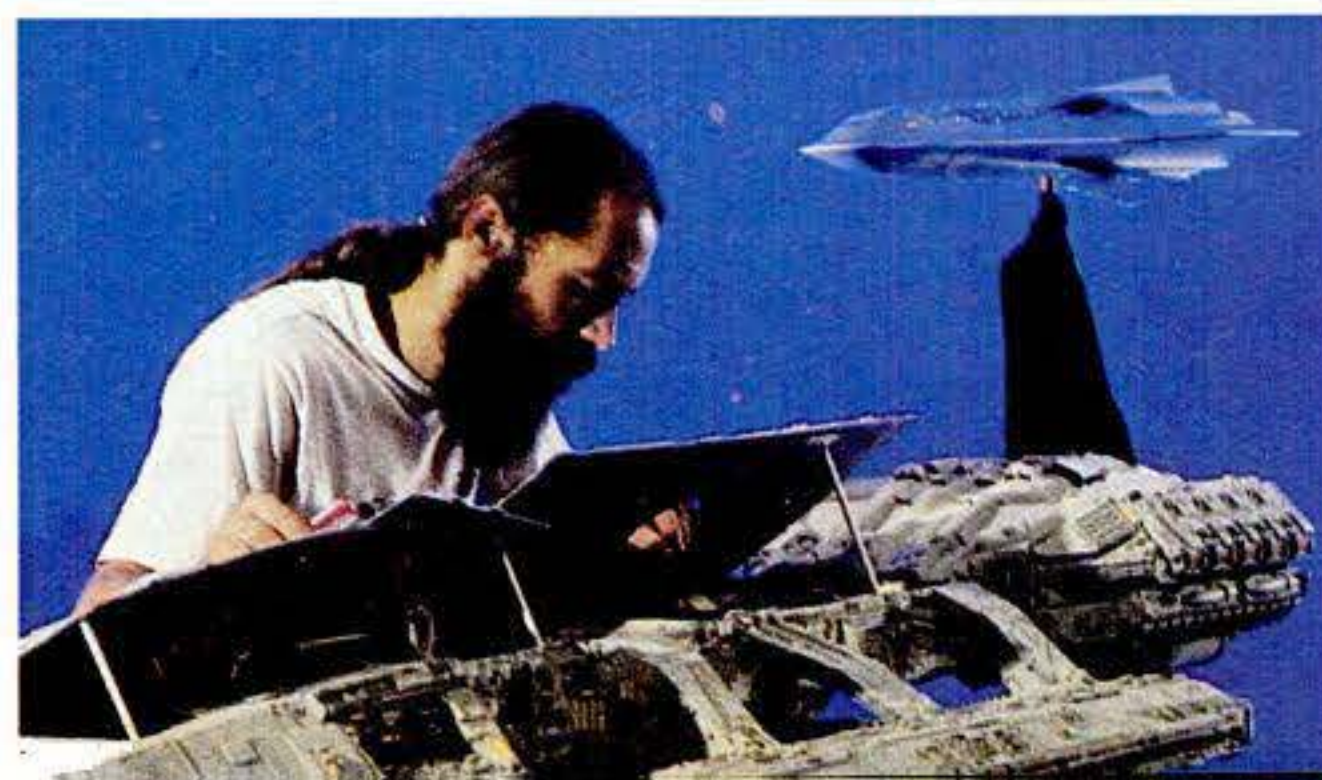


Finger-thick cable with 144 fibers was developed at Bell Labs and is being manufactured by Western Electric for regular telephone use. Bell's digital FT3 system carries pulses of light at 44.7 million bits (megabits) per second. This enables each pair of optical fibers to carry 672 telephone conversations.



Plastic model shows how voice sound waves (left) become a digital code for transmission as light pulses through phone-system optical fiber (foreground). Converted to electrical signal (right), voice

is sampled 8000 times a second, and samples are assigned a number from zero to 255, representing wave height. In microsecond, fiber carries 44.7 on/off pulses. Pulses behind 175 are its digital code.



Window lights on spaceship model used in "Battlestar Galactica" TV series and film are illuminated by plastic optical fibers channeling light from a single intense source. Du Pont and others also make plastic fibers suitable for telecommunications over short or medium distances.

"It's everyone's dream to make a fiber with such properties that it

Yet even as the Bell System's Western Electric is now producing standard light-guide (FT3) systems, researchers are perfecting optical-fiber communication by, among other things:

- Boosting production efficiency and finding ways to make glass as clear as possible for existing light sources.
- Creating fibers with super signal-carrying capacities and testing them in cables for transatlantic use.
- Improving new long-wavelength light sources that can beam signals much farther through fibers, and help engineers send signals simultaneously with several different "colors."
- Creating fibers from "nonglass" materials that are 1000 times more transparent to certain light sources than today's already incredibly clear glass threads.

One quality of optical fibers that excites people in the telecommunications industry is their tremendous bandwidth potential—the capacity to carry information. Bandwidth is potentially several thousand times greater than with wire-based systems.

This ability to carry thousands of telephone calls in thin, lightweight cables is tremendously useful in the overcrowded ducts beneath our streets. Optical cables can snake through spaces in telephone ducts too small for wire cable.

Before optical-fiber transmission, the electrical signal from a telephone call is first converted into an on/off digital signal. This digital signal flashes a semiconductor laser or LED on and off, beaming light pulses into an optical fiber.

If the light pulses travel over four miles, a glass fiber weakens and alters them enough (see box) so that a repeater amplifier is required. Repeaters have an extremely sensitive solid-state photodetector for each fiber that senses and amplifies the weak pulses. Electronic circuits then flash another laser, passing exact duplicates of the original pulses along to the next fiber. At the end of the line, circuits convert the digital pulses back into conventional electrical signals for the receiving telephone.

That four-mile spacing between repeaters, however, is a significant improvement, since conventional copper-wire cables need one-mile repeater spacings. For fibers, this means fewer repeater amplifiers with fewer outages and service calls.

As they flash along threads of glass (an insulator), the light pulses are immune to EMI (electromagnetic interference) that can distort signals on

copper wires. Also, unlike metal conductors, optical fibers don't radiate electromagnetic signals that adjacent fibers might pick up (crosstalk). Finally, since fibers are made with the abundant raw materials used for glass, they're likely to become less expensive than conventional cables made from copper. A mile-long thread of optical fiber can be created from a teaspoon of raw material. Volume production, though, is needed to trim costs of complete optical-fiber systems (electronics plus fibers).

Fiber trunks

Your telephone calls may already have been piped through optical fibers. For several years, trial installations—mostly so-called interoffice trunks in cities—have been tested or put into service around the world.

The Bell System has tested setups in Atlanta and Chicago, and has customized installations elsewhere. Its first installation with standard FT3 hardware (44.7 megabits/sec) is slated for service in December—a 6.5-mile

“There's the possibility of putting signals from two, four, or many sources onto one fiber”

cable route linking phone-company offices in Atlanta. Thereafter, about every two months, FT3 optical-fiber systems will go on line in San Francisco, Pittsburgh, New York, and elsewhere.

GTE companies have installed a dozen or so fiber systems, including a 5.6-mile Los Angeles link. ITT has systems here and in Great Britain. Harris Corp. is completing a 32-mile optical-fiber system for Canada's Alberta Government Telephone system. It will operate at the highest North American telephone digital rate (T4, or 274 megabits/sec) and be able to handle 20,160 calls on only six pairs of glass fibers.

Bell Canada uses several optical-fiber systems. They've also tied 36 subscribers in Toronto's Yorkville district directly to a switching center through fibers. By 1986, Bell Canada expects to connect urban households routinely into fiber links, supplying voice and two-way TV-based information banks similar to the British Prestel or Viewdata [PS, May '78].

Manitoba's telephone system is

readying a similar system now for a trial with 150 subscribers in a rural town.

The most advanced two-way interactive fiber system is called Hi-Ovis. It's in a 1400-home town near Osaka, Japan. Subscribers can use their TV's for video telephone service to other subscribers, receive cable TV, request entertainment from centralized TV-cassette storage (loaded by automated machines), or call up information from a still-picture bank.

Some experts believe wide-scale applications of fiber similar to Hi-Ovis, perhaps with phone lines, may be 20 years away. At Bell Labs I saw work underway to trim component costs and make wired-city concepts more practical one day.

At Bell's Murray Hill facility, Mel Cohen, who heads a research and development group, showed me a hollow glass tube being heated to create a preform from which fibers are drawn. The process, he explained, is only about 35-percent efficient. As evidence, he pointed out a white sandlike substance, powdered silica, tumbling at both ends of the tube as it spun on a lathe.

To make the graded-index fiber used by Bell (see box), ultrapure liquids—silicon and germanium tetrachloride—are converted to gases and forced with oxygen under computer control through silica (SiO_2) tubes. Heat oxidizes the gases, creating doped-silica coatings inside the tube. By altering the concentration of gases, some 50 silica layers with different refraction indexes build up. But because the technique is still inefficient, a lot of silica forms and rolls wasted to the tube ends. Researchers are gradually learning how to boost efficiency.

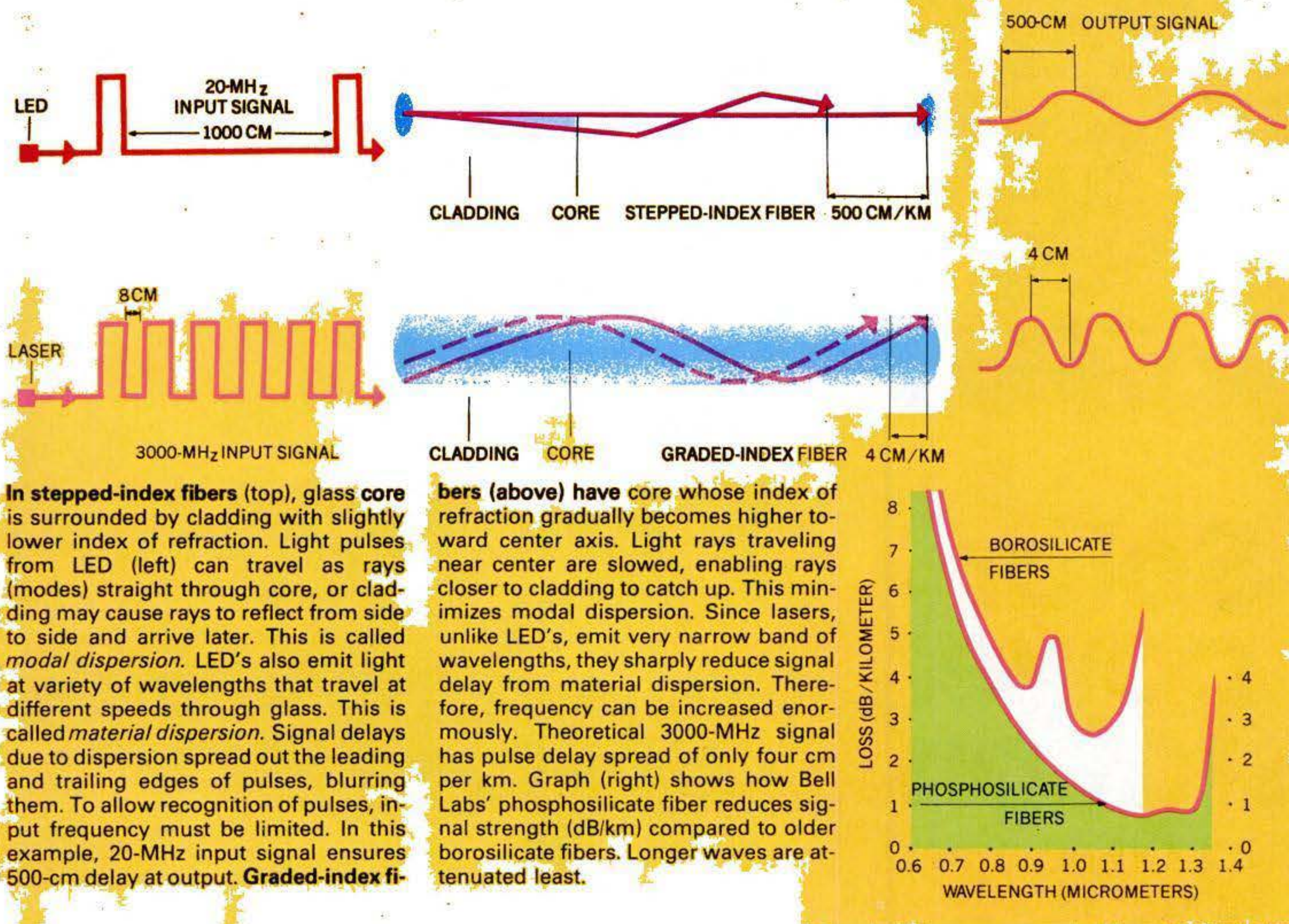
Preform projector

Earlier, at another location, Bell Labs researcher Herman Presby showed me a simple but ingenious technique he and colleagues developed to check these silica layers in preforms. Presby picked up a yard-long, crystal-clear preform and placed it on an optical jig. "The nice thing about this," he said, "is that this length of preform corresponds to about five kilometers of fiber."

His technique, using a vibrating mirror and lenses, spreads a laser beam into a rectangular pattern that is projected through a preform. A large screen before me turned a brilliant ruby red, revealing minute details about individual silica layers in the preform sample, plus defects that would spoil a fiber drawn from such a rod. Computer analysis is able to

could do the job of the transatlantic cable, but with no repeaters"

How light pulses travel through optical fibers



In stepped-index fibers (top), glass core is surrounded by cladding with slightly lower index of refraction. Light pulses from LED (left) can travel as rays (modes) straight through core, or cladding may cause rays to reflect from side to side and arrive later. This is called *modal dispersion*. LED's also emit light at variety of wavelengths that travel at different speeds through glass. This is called *material dispersion*. Signal delays due to dispersion spread out the leading and trailing edges of pulses, blurring them. To allow recognition of pulses, input frequency must be limited. In this example, 20-MHz input signal ensures 500-cm delay at output. **Graded-index fi-**

bers (above) have core whose index of refraction gradually becomes higher toward center axis. Light rays traveling near center are slowed, enabling rays closer to cladding to catch up. This minimizes modal dispersion. Since lasers, unlike LED's, emit very narrow band of wavelengths, they sharply reduce signal delay from material dispersion. Therefore, frequency can be increased enormously. Theoretical 3000-MHz signal has pulse delay spread of only four cm per km. Graph (right) shows how Bell Labs' phosphosilicate fiber reduces signal strength (dB/km) compared to older borosilicate fibers. Longer waves are attenuated least.

evaluate preforms automatically.

In another lab, Cohen showed me a nine-foot-high RF-induction furnace and mechanism for pulling fibers at the lab, which was out of service. As technicians worked on it, Cohen pointed to the ceramic tube on top that glows white hot and melts a preform inserted in it. A wastebasket-size drum on the floor spins and pulls fibers from preforms at a brisk 15 feet a second or more.

Someone showed me a small bowl of liquid plastic between the heater and drum. It coats fibers with a protective cover. "One limitation now in speed is how fast the plastic coating will dry," said Cohen. To meet expanding production, the protective coating must be dried faster.

Gradual improvements in fiber-making technology now enable Bell to make extremely "dry" fibers. Water molecules created chemically in the glass can absorb light rays at certain wavelengths. This loss, measured in decibels (dB) of light intensity per kilometer, is critical in determining how often repeaters must be installed. Part of the trick is using chemicals

with exceptionally small amounts of hydrogen-bearing impurities. "We use our own special in-house processing," said Cohen. "We've developed techniques for purifying chemicals."

The newest "dry" fibers are radically better than fibers made just a few years ago. With a light source of 1.39-micron wavelength, fibers reduce signals only 0.3 dB/km instead of 30 dB/km. But light sources—lasers or LED's—at this wavelength haven't been perfected enough for field use, while lasers at 0.82 micron have.

Transatlantic cable

Cohen showed me a section of an experimental undersea cable that will make use of the longer-wavelength light sources. The one-inch ocean cable is twice as thick as terrestrial FT3 light-guide cable. It has central steel wires for strength and electrical power, but carries only 12 fibers. At long wavelengths, 1.3 microns or above, repeater spacing might be as far apart as 20 miles when the cable is put down later in the decade. Although it's half the size of the Bell System's current 4200-circuit coaxial transatlantic ca-

ble, the optical-fiber cable could provide well over 8000 circuits.

The planned use of so-called single-mode fibers insures this large bandwidth. Bell's FT3 graded-index fibers have 50-micron cores that let many light rays (modes) through, but distort signal pulses (see box) so that the pulse frequency and amount of information carried must be limited. Single-mode fibers have cores only seven to nine microns in diameter and permit just a single ray of light to pass straight along the core axis. Without the pulse-distortion effects from numerous light rays, frequencies can be increased to phenomenal rates.

But there are practical limits, as Tingye Li at Bell's Crawford Hill labs explained. Li heads the circuits and transmission department, exploring ways to maximize the amount of information fibers carry. Although single-mode fibers can theoretically carry 100 gigabits (100 billion bits) a second per kilometer, no lasers can operate at this rate presently. Li estimates the best rate today is about two gigabits/sec in a laboratory only.

[Continued on page 180]

Solar power station

for oil-rich Kuwait

Swiveling and tilting on its angled base, the mirrored collector dish follows electronic instructions to track the sun across the sky despite passing clouds. Mounted on a rigid boom, the spherical energy absorber sits at the exact intersection of the two tracking axes. Thus, flexible feed lines or movable pipe joints aren't needed to carry the working fluid to the sphere.

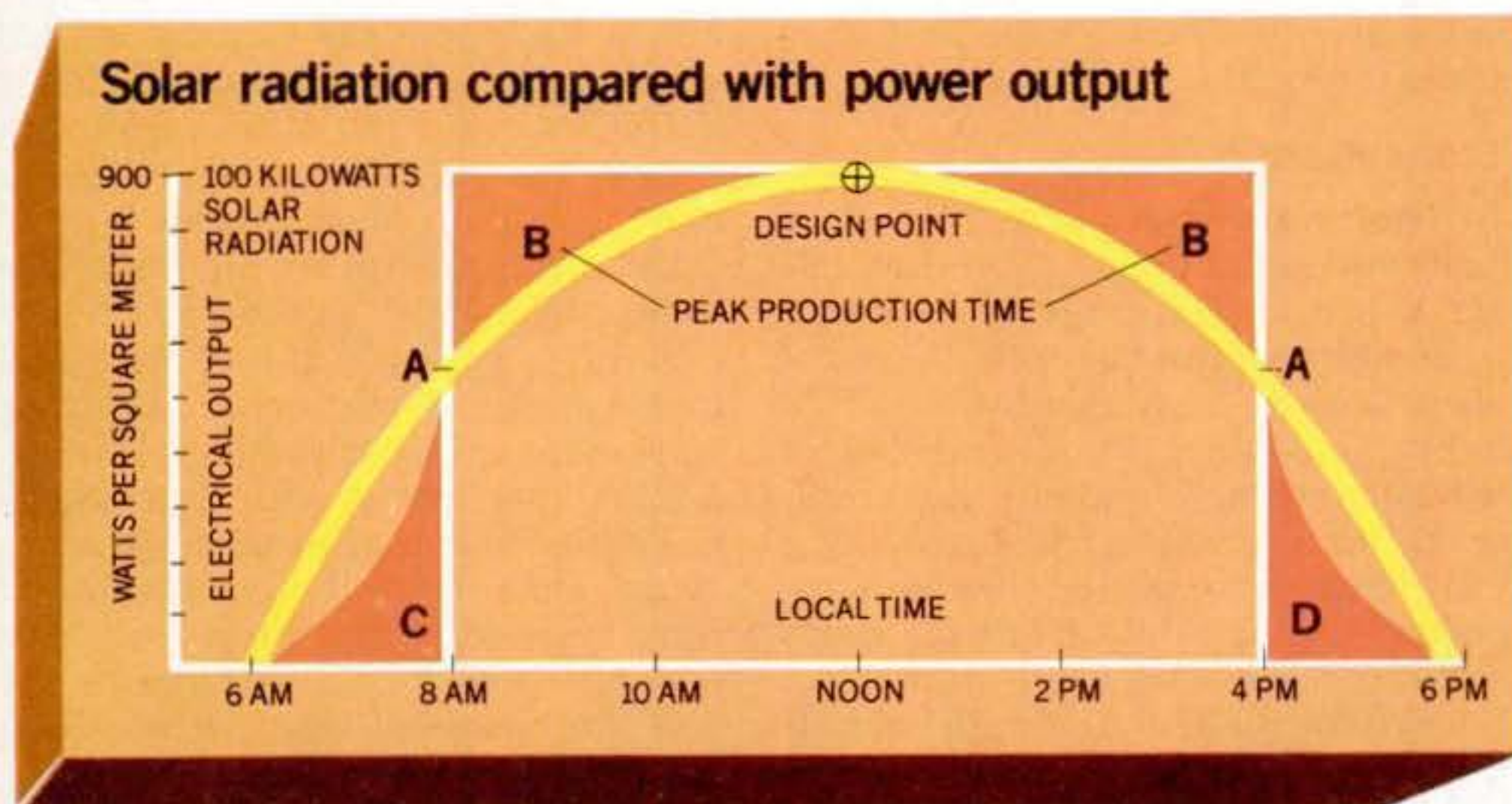
Giant collectors employ aerospace technology to track the sun

By DAVID SCOTT
GRAPH BY ROBERT RITTER

Ranged along two acres of sun-baked desert fronting Kuwait Bay, 75 giant mirrored reflectors stand facing the sun. At the focal point of each reflector dish is a unique energy absorber—a glowing copper ball the size of a grapefruit. The entire array powers a 100-kW electric generator that produces over 800 kWh of energy daily (see graph).

Why does one of the world's richest oil-producing nations want a solar farm? Simple. The solar power plant will free more oil for export. Initially,

Though sun's radiation output (A) varies throughout the day, power output of the Kuwaiti system is kept steady during peak hours (B) by heat energy stored in an insulated tank. The system generates a constant 100-kW output for eight hours, or 800 kWh of energy daily. Off-peak heat storage (C & D) is less because some reflectors shade each other. Still, the insulated tank lets the system collect low-level radiation and permits limited power output after sunset.



the plant will provide electricity for irrigation pumps and desalination plants. But later it may be tied into the national energy grid as a supplementary source of oil-saving power for industry.

Designed and built by Germany's leading aerospace company, Messerschmitt-Bölkow-Blohm, the \$3.5 million installation has efficiency-boosting features derived from space technology.

The unique copper energy absorbers are based on the design of rocket-engine combustion chambers. Intense solar heat gathered by each giant reflector is concentrated on the 14-cm.-dia. (5.5 in.) hollow spheres for maximum heat transfer. As in rocketry, a

circulating fluid cools the copper. Flowing through a spiral channel milled on the sphere's surface, the fluid reaches 345 degrees C to produce 15 kW of thermal power.

This hot working fluid circulates in a closed loop through pipes that link all 75 collectors, combining their heat output. The loop passes through a generating station where the hot fluid vaporizes, then expands through the turbine to drive an electric generator. The exhaust gas is then condensed to a liquid, which is pumped back to the absorber spheres.

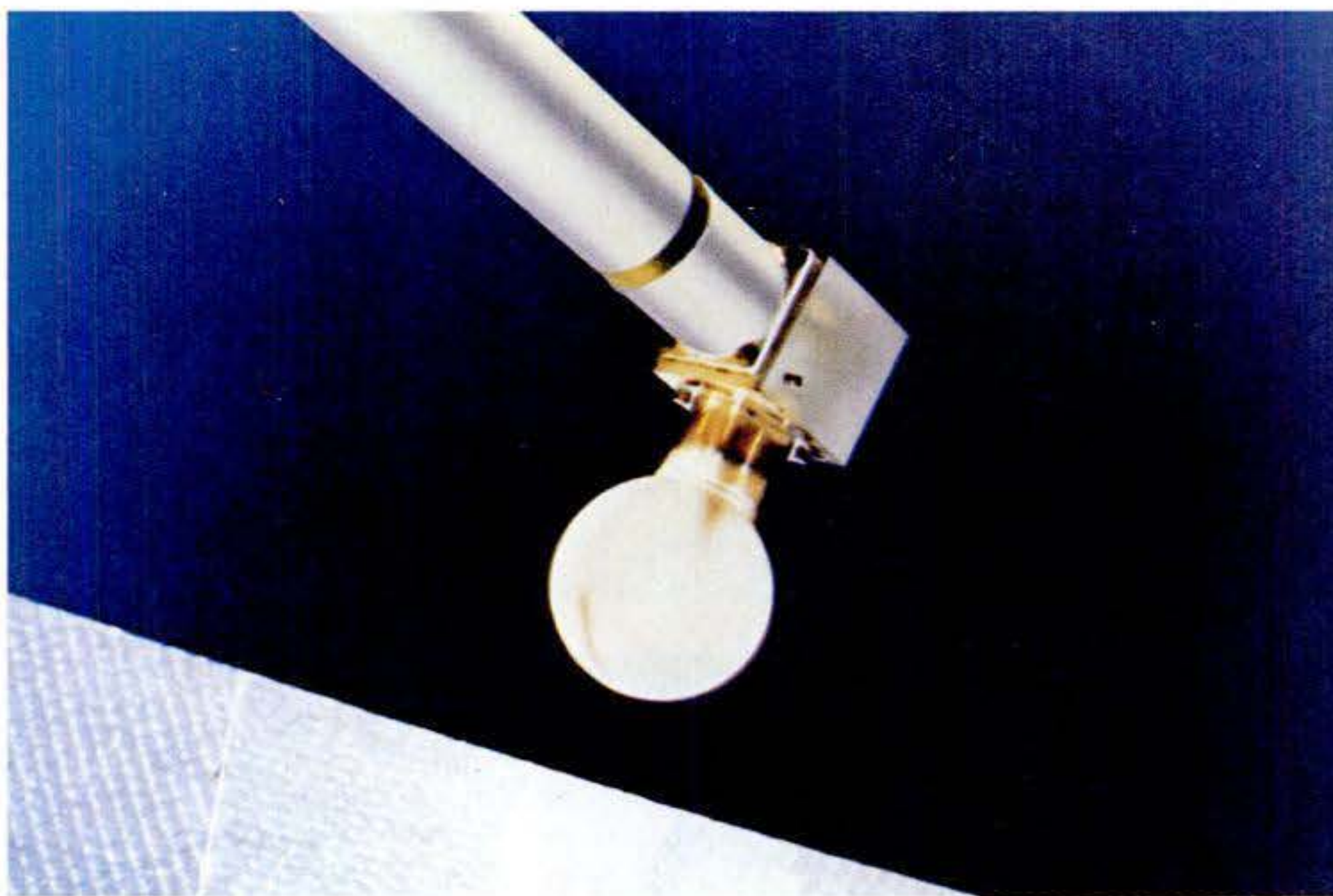
An insulated tank, tied into the generating loop, stores enough hot fluid to run the turbine for two sunless hours, keeping the generator running

at full output during cloudy periods.

Sophisticated computer programming, another space-technology spin-off, keeps the reflectors on target as the sun creeps across the sky. Adapted from satellite-tracking systems, the program is consistently accurate to within a quarter degree—far more precise than optical aiming.

The computerized tracking system also improves energy collection. Since reflectors always follow the sun's path, the dishes face the sun whenever it breaks the clouds. With conventional photoelectric sensors, repointing the mirrors after a shady period can waste energy-packed minutes.

Scheduled to begin operation later this year, this space-age solar farm is a pilot scheme that could be expanded to a 500-kW generating plant. It could become a total energy system simply by using the waste heat from the air-cooled condenser (in the generating plant) to power a heat pump. **ES**



Glowing like a light bulb (left), the copper absorber ball at the mirror's focal point is heated white-hot by the concentrated solar radiation directed at it. The cooling effect of a circulating fluid keeps the hollow sphere from melting. The fluid flows through the spiral channel milled on the sphere's surface (above). After machining, the groove is enclosed by an electrically deposited, three-mm layer of copper. A final black coating allows maximum heat transfer.



A mosaic of tiny mirrors glued to a lightweight fiberglass shell makes up the parabolic reflector dish. The mirror squares are small enough to follow the dish curvature precisely. They provide a weather-proof, noncorrosive surface that needs no polishing. Assembled in segments, the finished dish is 5.9 m (19.5 ft.) in diameter. Similar construction techniques are used to build solar panels for spacecraft.

What's New

A PICTURE ROUNDUP OF NEW PRODUCTS AND DEVELOPMENTS



Royal hydrofoil

HMS Speedy, a military hydrofoil purchased from Boeing by Britain's Royal Navy, can exceed 50 knots if it performs like sister commercial Jetfoils with waterjet propulsion. The RN may use the 90-ft. craft to protect offshore fisheries and oil/gas installations.



40-kW wind turbine

Twenty-mph winds spin the blades on its wind-turbine generator to deliver 40 kW of electrical output, says Kaman Aerospace Corp. (Bloomfield, Conn.). Two 32-ft. fiberglass rotor blades are mounted downwind. The machine, built for industrial use, is being tested.

Reflector strip

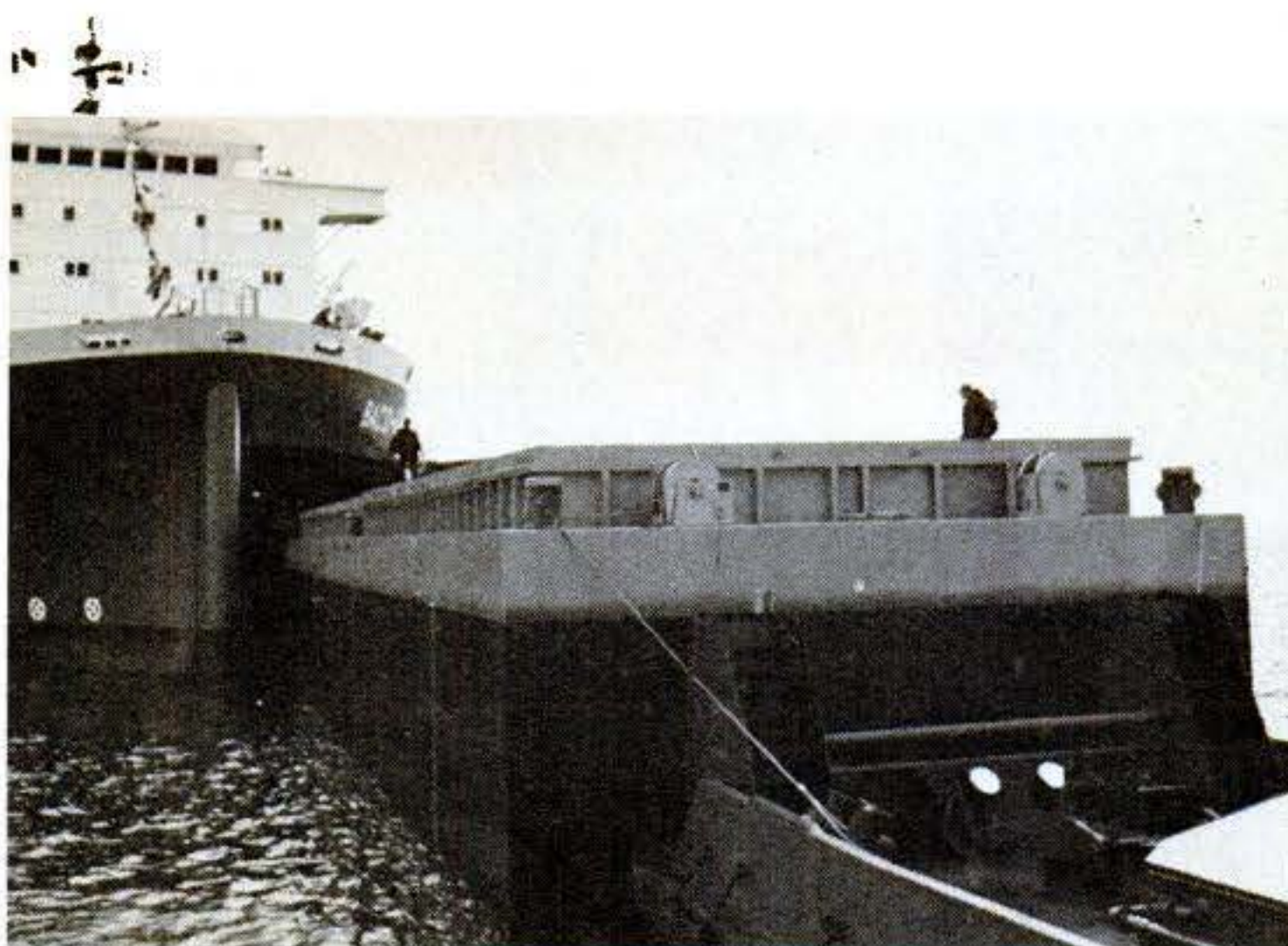
You'll spot this train-crossing sign—or anything else—up to one mile away with Reflect-O-Strip on it, says the maker (Mohs Seaplane Corp., 2355 University Ave., Madison, Wis. 53705). The patented, 1 $\frac{3}{8}$ -in.-wide plastic extrusions are twice as reflective as some commercial tapes, according to the inventor.

Bicycle engine

Mount the Bike Machine on most bicycles and the one-hp, two-cycle engine lets you cruise up to 20 mph. The engine can be installed in minutes with ordinary tools, says K&S Industries, Box 612, Fort Worth, Tex. 76101. Fuel mixture is 20:1 gasoline to motor oil.

Barge swallower

Flood Baco-Liner 1's hull and the 21,000-ton German container ship can swallow 12 loaded barges through bow doors. The 800-ton barges are then clamped to the 475-ft.-long central berth, the doors closed, and water pumped out to raise the ship to sailing height.



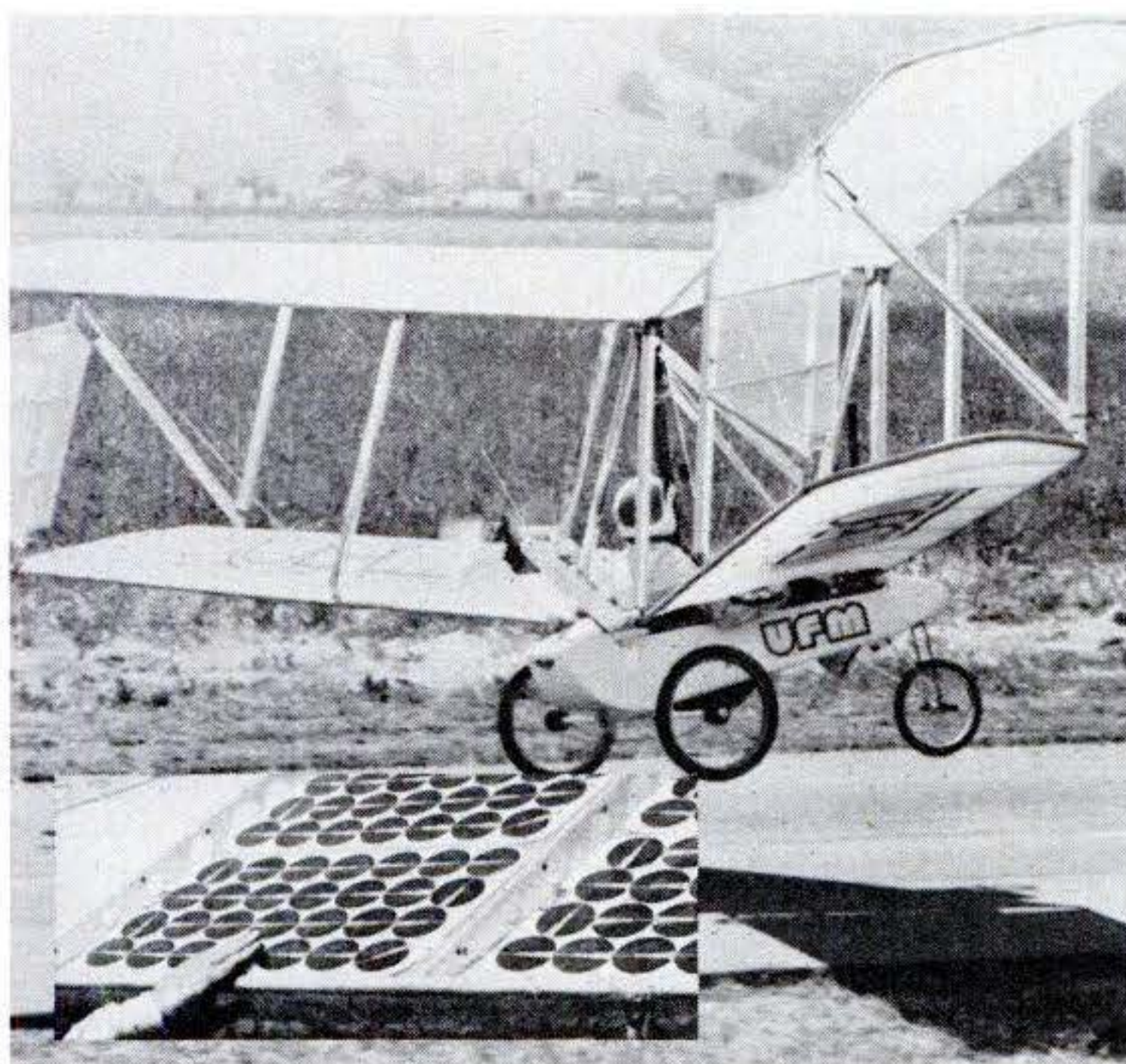


6WD Land Rover

Add a third driven axle to the formidable British Land Rover and it becomes a go-anywhere six-by-six that climbs 45-degree gradients or churns easily through deep mud or sand. The new model, called the Sandringham 6, handles a two-ton payload.

100-mpg car

Free-Way, a one-passenger, three-wheel economy car, gives you 100 mpg or refunds its \$2800 price, says H. M. Vehicles, 1116 E. Highway 13, Burnsville, Minn. 55337. A one-cylinder, 345-cc engine with automatic transmission, squeezes 900 miles from a tank, says the maker.



Electric biplane

Panels with 500 solar cells on the top wing (inset) help power this hang-glider biplane (not sold). Inventor Larry Mauro of Santa Clara, Calif., made a brief 20-mph flight, with cells charging a battery that drives a three-hp electric motor and prop.

Square cells

Squared-off solar cells offer 20 percent more density on panels than conventional round photovoltaic wafers, says Motorola. Prices: \$199, \$298, \$476, for 10-, 20-, and 40-watt modules, respectively (100 units and up). Motorola, Box 20912, Phoenix, Ariz. 85036.



Stepless buses

Boarding eight experimental Volvo buses in Halmstadt, Sweden, is easy when floor-level gangplanks slide out flush with elevated route stops. Wheelchairs and strollers roll on and off. Automatic steering at raised stops uses magnetic-guidance loops to ensure bus spacing.

All-terrain vehicle

Snow, marshes, or deep water can't stop the Croco all-terrain vehicle, says the manufacturer. The 4WD vehicle has large, low-pressure tires and two watertight hulls that roll independently. A 32-hp rotary engine drives an automatic two-speed transmission. Croco Ltd., CH-6056 Kagiswil, Switzerland.



What's New IN PHOTOGRAPHY

BY E. H. ORTNER

SLR system with LED displays

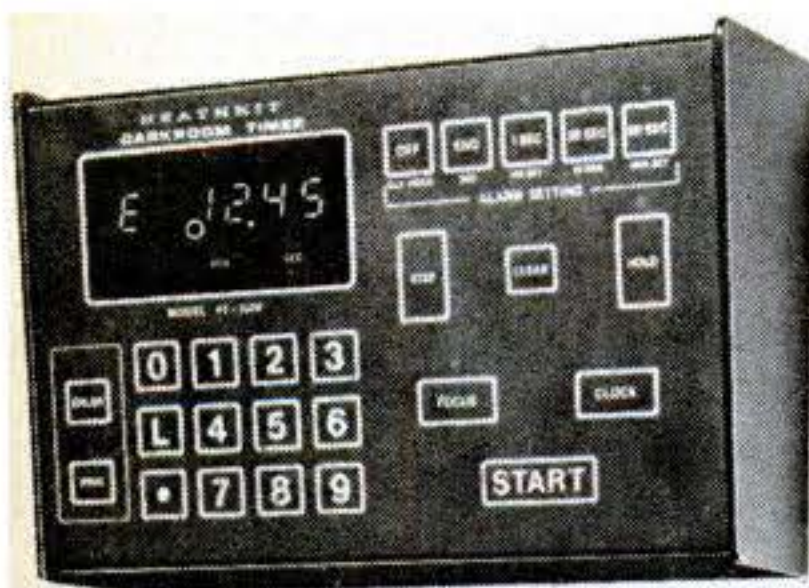
Three new SLR cameras, six new bayonet-mount lenses, and a range of new accessories make up the new Fujica X system. All have LED indicators in their viewfinders.

The top-of-the-line AX-5 (shown) has five automatic modes (aperture and shutter priority, programmed and stopped-down auto exposure, electronic-flash auto exposure) plus manual. A double row of LED's shows aperture and shutter speed. With f/1.6 lens, it's \$625. The AX-3, with both aperture-priority auto exposure and manual, is \$445. The all-automatic AX-1 is \$400. The Auto Strobe 300X flash shown lists for \$135.



Close-up flash

Two heads, one on each side of the lens, give even light for close-up photos with the Canon Macrolite ML-1. The unit provides automatic exposure, with a three-f-stop range, for a variety of lenses by way of adapters. Eight penlight cells power the battery pack. Price: \$422.



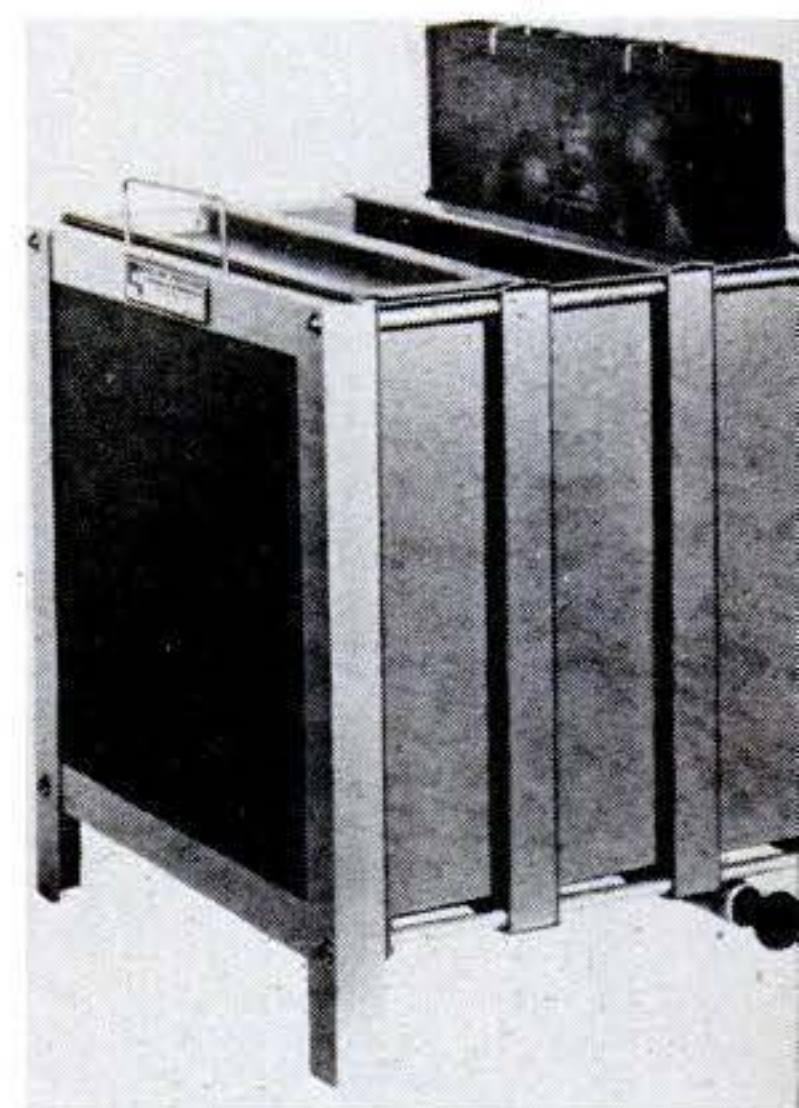
Timer kit

The Heath PT-1500 remembers up to nine processing steps, plus an enlarging step, to control, via LED's, your darkroom operations. It also controls enlarger and safe-light outlets, plus an external device such as a color drum. The kit is \$119.95 from Heath Co., Benton Harbor, Mich.



Darkroom meter

Put the Omega Exposure Comparator on your enlarging easel, and LED's tell you when you've got the right lens-opening/exposure-time combination for best printing. The battery-powered unit has a six-stop sensitivity range and time scale of 1.5 to 120 sec. It's \$49.95.



Print processor

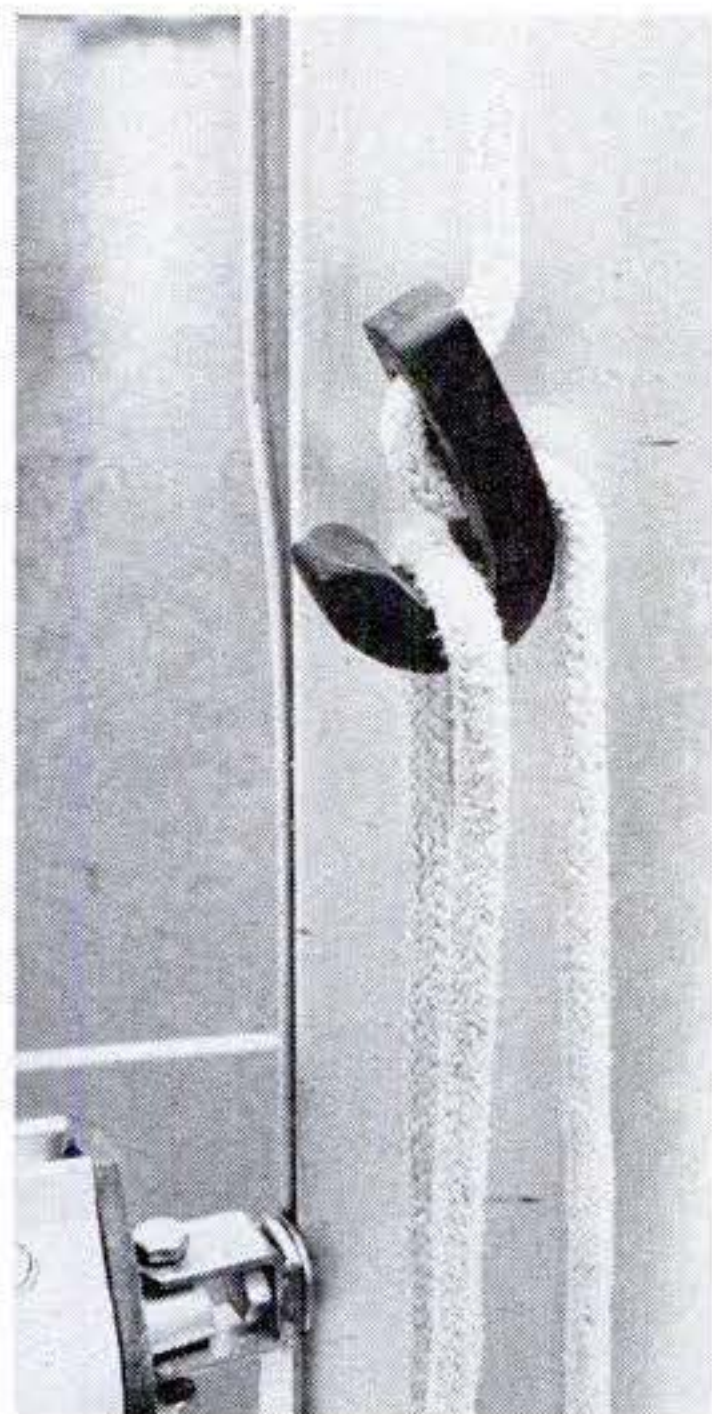
Fourteen 8-by-10 color prints in 9½ minutes is the claim for the Moduline 100-3 compact processor. The pre-plumbed plastic unit holds a gallon, and includes two solution tanks and a dump-type wash tank. Photographic Instruments Co., 11911 Franklin Ave., Franklin Park, Ill. 60131.

Slide maker

A finished black-and-white 35-mm slide in 40 seconds from line art up to 11 by 17 inches—that's the claim for the new Panacopy unit. You load it with premounted slides, push a lever, frame and focus, hit a start button. That's all, says Durst (641 So. Rockford Dr., Tempe, Ariz.).

What's New IN BOATING

BY SUSAN RENNER-SMITH



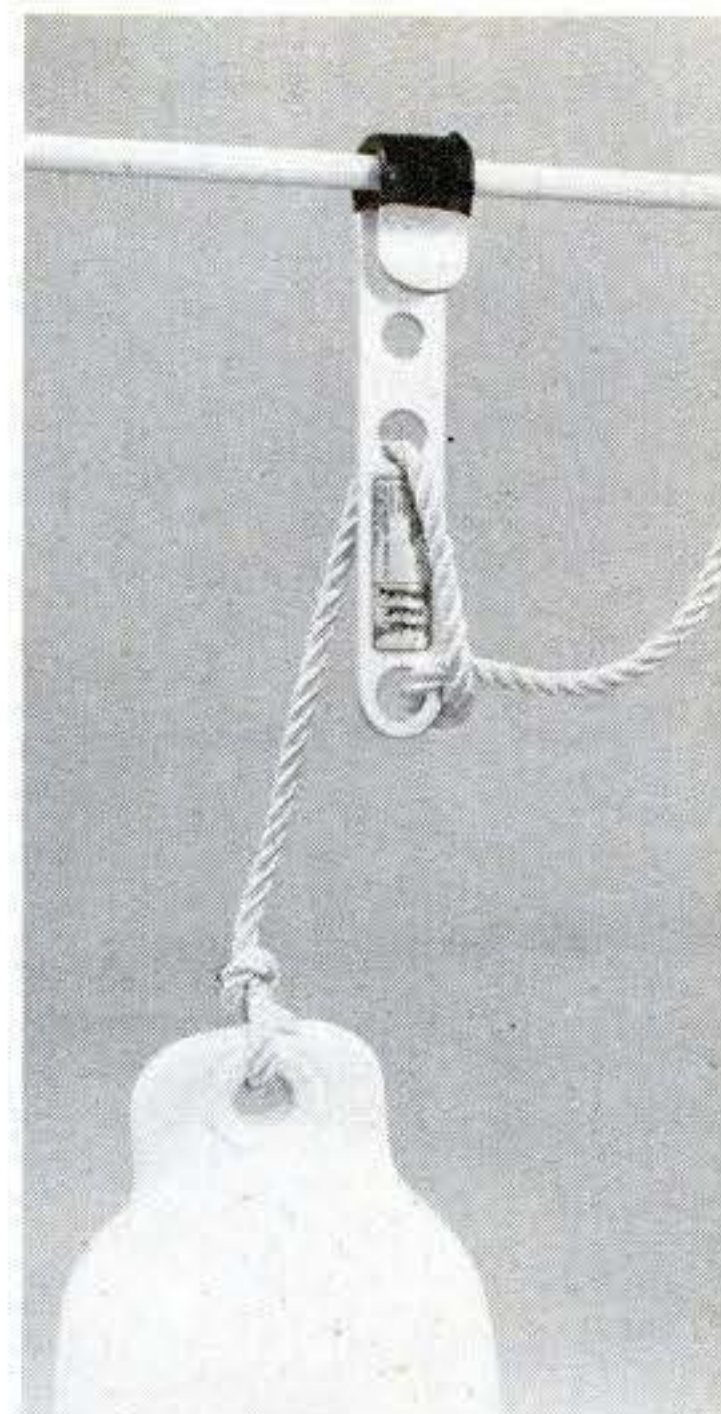
Line puller

It's just a slotted polyethylene hook, but the Tugger gives sailors a three-to-one mechanical advantage when snugging up halyards and other lines. The line tensioner costs \$7. United Yachting Mfg., 23230 Tireman Ave., Dearborn Heights, Mich. 48127.



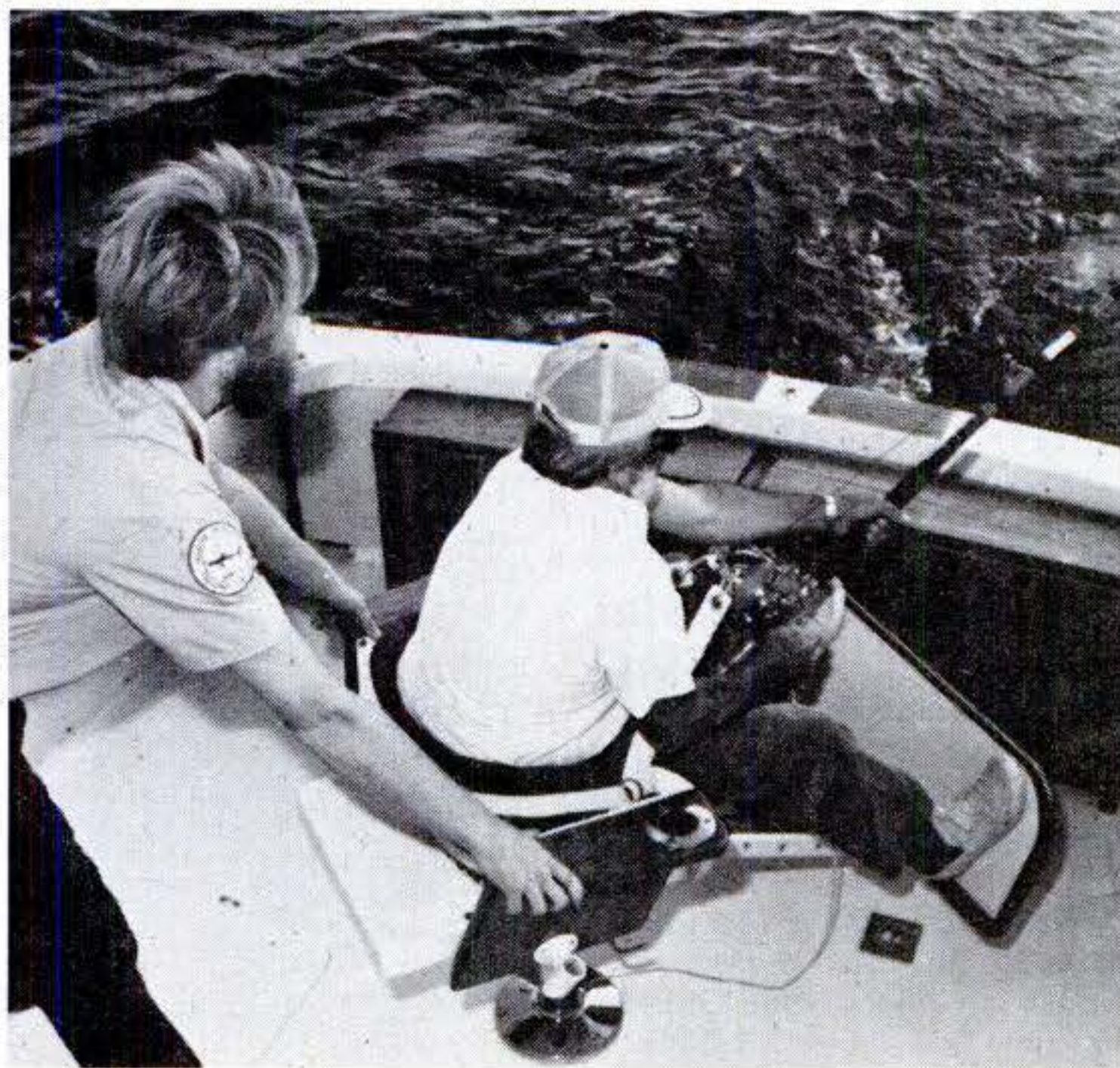
Saucy double-ender

Designed for families, this perky little daysailer is almost all cockpit. The Scaffie's 14' 9", lapstraked fiberglass hull has positive flotation. The craft also has a loose-footed sail on an unstayed mast. This boomless rig makes jibing safe and easy, even in strong winds. The sail rig stows in the cockpit for easy transport, but assembles in seconds, says maker (Drascombe Boats, Box 878, Camden, Me. 04843). The 460-lb. craft also has a long, shallow keel for easy trailering. Price, with sail and oars, is \$3475.



Fender locker

Tired of tying and untying fender lines? With the Insta-lock, a quick shove on the looped line adjusts fender height. The anodized aluminum hanger fits lifelines (\$9 a pair) or rails (\$10 a pair). New Dimension Designs, 1118 Sanger St., Philadelphia, Pa. 19124.



Compact fighter

Landing a big game fish is easier with the new Blue-Fin fighting chair aboard. Its 30-in. turning radius is 10 inches less than other chairs, freeing more deck space for wrestling with the fish. Blue-Fin Prod. (505 Shore Acres Ave., N. Kingstown, R.I. 02852) makes it. \$1500.



Pole vent

A simple telescoping pole does double duty on tarp-covered boats. A unique cap (above right) vents out damaging moisture. The Vent-So-Port pole also keeps the tarp taut (right), so rain drains off instead of pooling. Tex-All Co., Box 3038, Montrose, Mich. 48457. \$25.



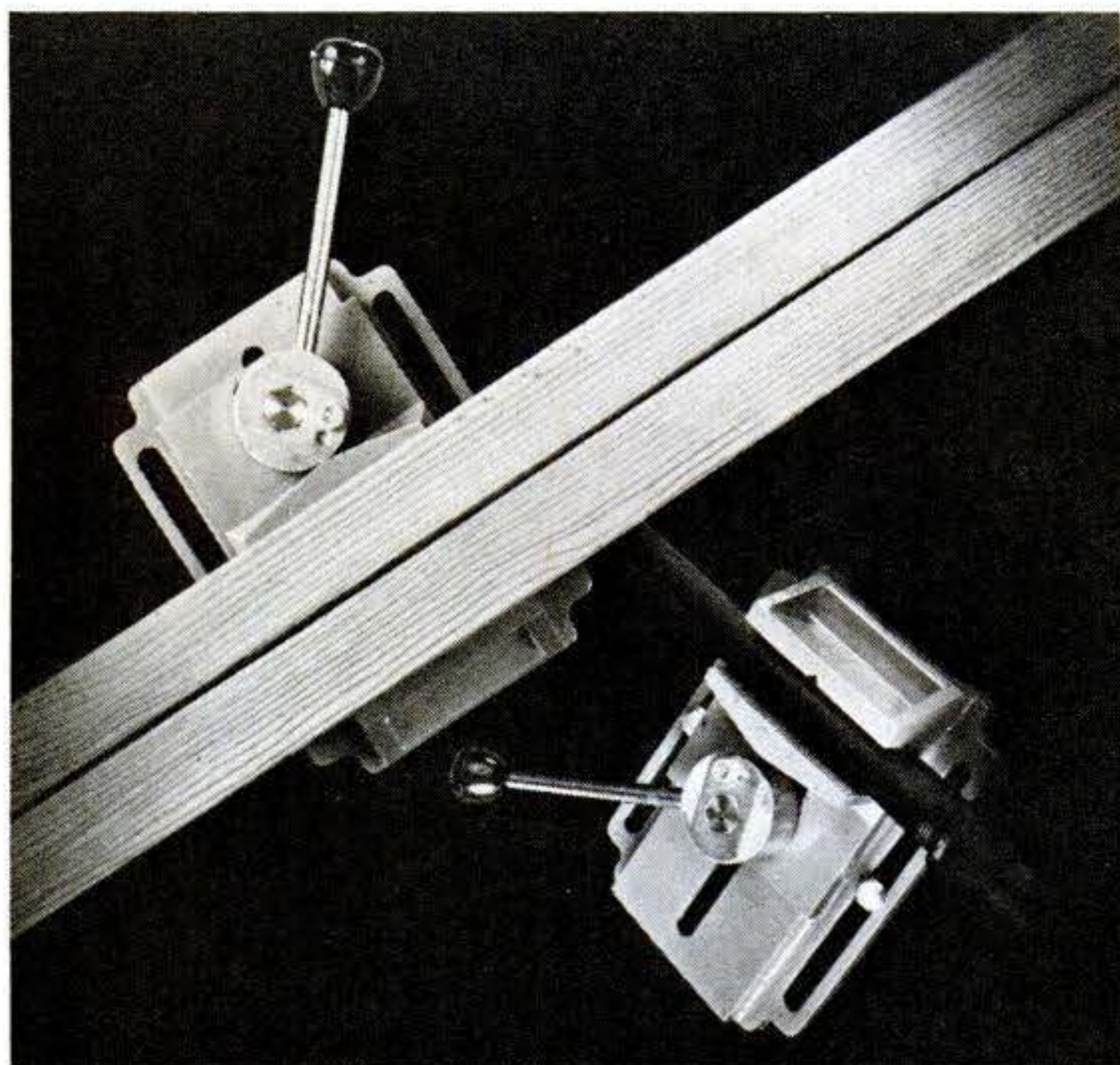
What's New IN TOOLS

BY R. L. STEPLER



Buffer/grinder

Air-driven zero-to-16,000-rpm tool comes with attachments for buffing, sanding, routing, and deburring. Driven by 90-100-psi air, model 2R consumes about four cfm. Price: \$101, including four tungsten-carbide and three vitrified bonded stone tools. Hale Engineering, 119 Liberty St., Danvers, Mass. 01923.



Fertilizer

Chemilizer's calibrated injector distributes liquid fertilizer into the water supply. Your sprinkler does the rest. The molded plastic unit comes in two- and four-gallon sizes, costs \$99.50. Maker: Chemilizer Products, 12745 49th St. N., Clearwater, Fla. 33520.



Vise/clamp

Pro Gripper combines the best features of a bench vise and a portable clamp, says Pro Sharp Corp. (Box 11378, Newington, Conn. 06111). It is light enough to be used as a portable clamp (top), yet heavy enough to be used as a bench-mounted unit (bottom). Price: \$29.95.

Nibbler

The Adel Nibbling Tool cuts holes in metal, plastics, and other material up to 0.0625 in. thick in any shape or size (7/16-in. dia. minimum). The device works on the same principle as a punch and die. It's under \$10, from Adel Tool Co., 4640 Ronald St., Chicago, Ill. 60656.



Paper-hanging kit

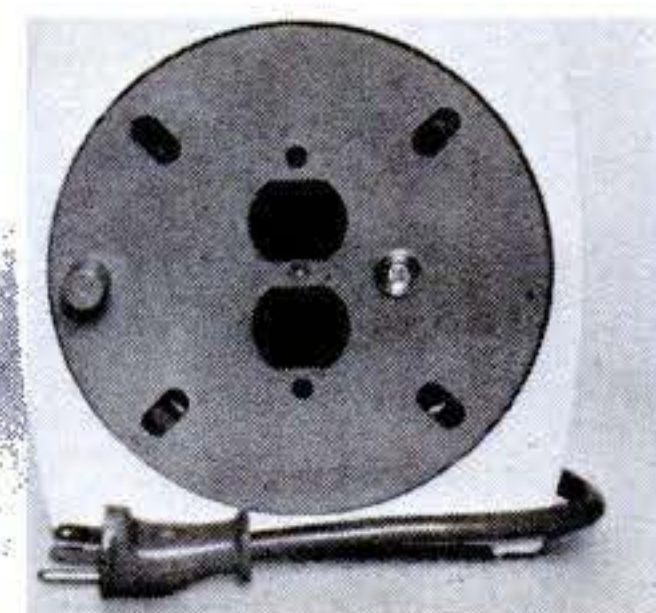
Red Devil's wall-covering kits include paste and sizing brush, smoothing brush, razor knife, and seam roller. One's for vinyl wall coverings, another's for wallpaper (shown). Each costs \$6.99.

Spatter stopper

Bothered by the "drizzle" of paint that's thrown off by conventional paint rollers? Padco says its Spatter Shield Roller solves the problem. The one-piece plastic applicator is said to weigh half as much as metal rollers. Price: \$5, including an all-purpose nap cover.

Power extender

Take power to your work site with Bench Boy: It's got almost 23 feet of 14-gauge cord on a wind-up reel, a heavy-duty duplex receptacle, and a built-in circuit breaker for safety. The unit is made by Fleck Manufacturing Co., Tillsonburg, Ontario, Canada.



What's New IN HOME IMPROVEMENT

BY R. L. STEPLER



Power accountant

Watts Happening's LED read-out converts your home's electric power consumption into cost per hour. You calibrate the solid-state meter to your local rate. Price: \$99.95. Maker: TAD Tech Corp., 6277 W. Williams Field Rd., Chandler, Ariz. 85224.



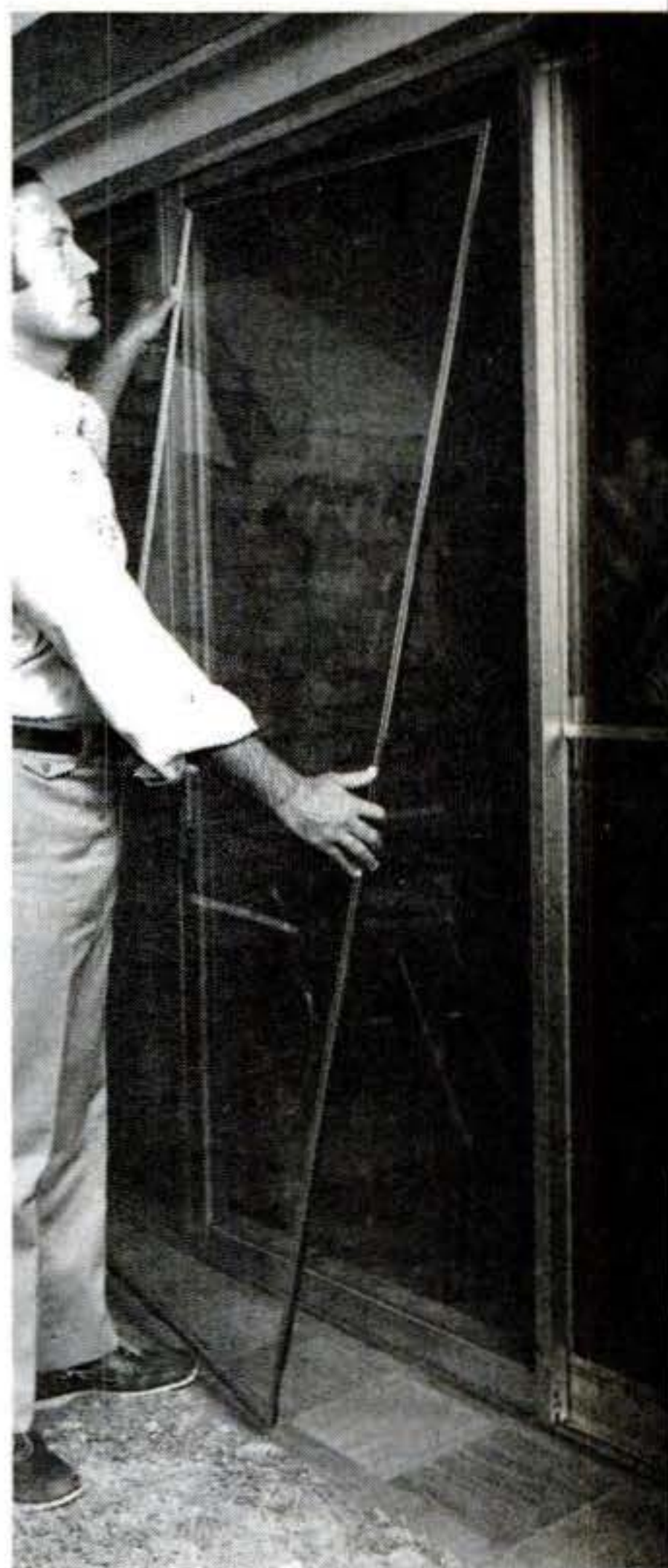
Energy saver

Jenn-Air's 30-in., energy-saving grill/range cuts power consumption in half when you're preparing small amounts of food on the unit's front or rear half. A no-hood surface ventilation system pulls smoke and odors into the range and vents them outdoors.



Plastic faucet

The flange and handle of this outdoor freezeless faucet are made of Lexan polycarbonate resin because of the material's impact strength and weatherability, according to the maker, Woodford Mfg. Co. (Box 3369, Des Moines, Iowa 50316).



Patio storm door

Aluminum-framed, PVC-film storm door can cut heat loss through a single-glazed patio door by 47 percent, says Reynolds (Box 27003, Richmond, Va. 23261). The do-it-yourself kit includes foam tape to attach the panel; Reynolds says it doesn't affect the door's operation.

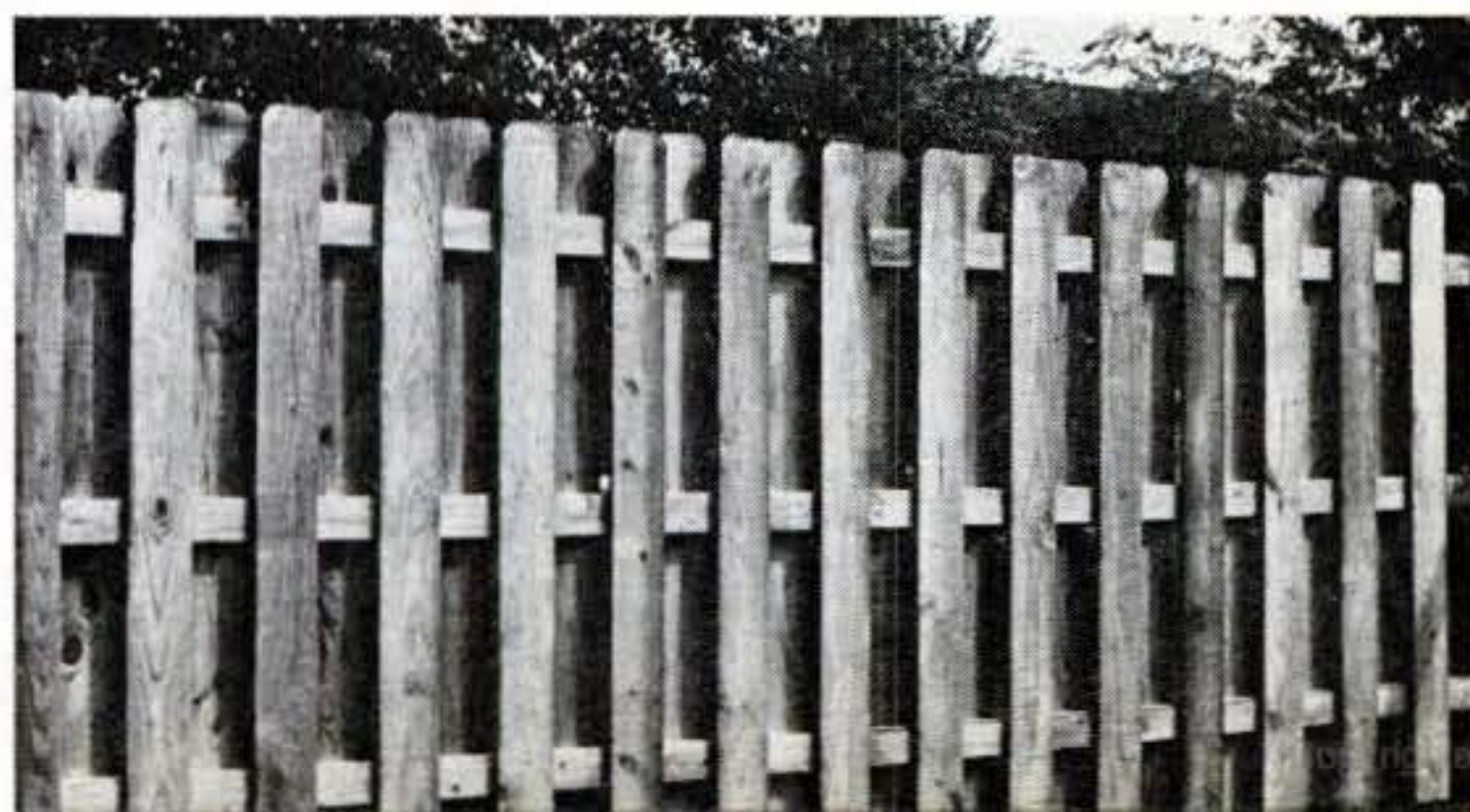


Grow window

Garden-Aire windows are double glazed to cut heat loss and condensation. The units come in 11 standard sizes, feature sliding side vents in a bronze, anodized-aluminum frame. They're made by Milgard Mfg., 1010 54th Ave. E., Tacoma, Wash. 98424.

Fence kit

You've a choice of board-on-board (shown), open picket, or solid privacy styles in Masonite's Select-A-Fence do-it-yourself fencing. The pressure-treated pine system consists of dogeared fence boards ($\frac{3}{4}$ " by 6" by 6"), 8' back rails ($1\frac{1}{2}$ " by $3\frac{1}{2}$ "), and 8' posts ($3\frac{1}{2}$ " by $3\frac{1}{2}$ ").



What's New IN ELECTRONICS

BY WILLIAM J. HAWKINS



Stereo clock radio

Anybody can wake up to music. But with this new GE digital AM/FM clock radio, you can wake up to stereo. Top-mounted speakers deliver two channels of FM stereo at the right time—the time you've set on its fluorescent displays. Slide controls vary volume, balance, tone. \$90.



Tiny radio/recorder

Sanyo's tiny microcassette recorder has big features: built-in AM/FM radio, two-hour record time, cue button, auto stop, auto record level, and tape counter. The handle snaps off to become a palm-sized dictation machine. Price: a not-so-small \$180.

Time machine

On which day will your fiftieth wedding anniversary fall? Tell Toshiba's LC-840WA the date, and it will show you the day of the week. It's preprogrammed for 200 years—from 1901 to 2099. The device is also a calculator, clock, and standard calendar. Price: \$60.



Digital receiver

Digital display of AM or FM frequency, six-channel memory, electronic channel scan, LED output meter—it has all the features of a \$1500 tuner. But Radio Shack's Realistic STA-2200 is a complete receiver (rated at 60 watts per channel), and the price is just \$600.

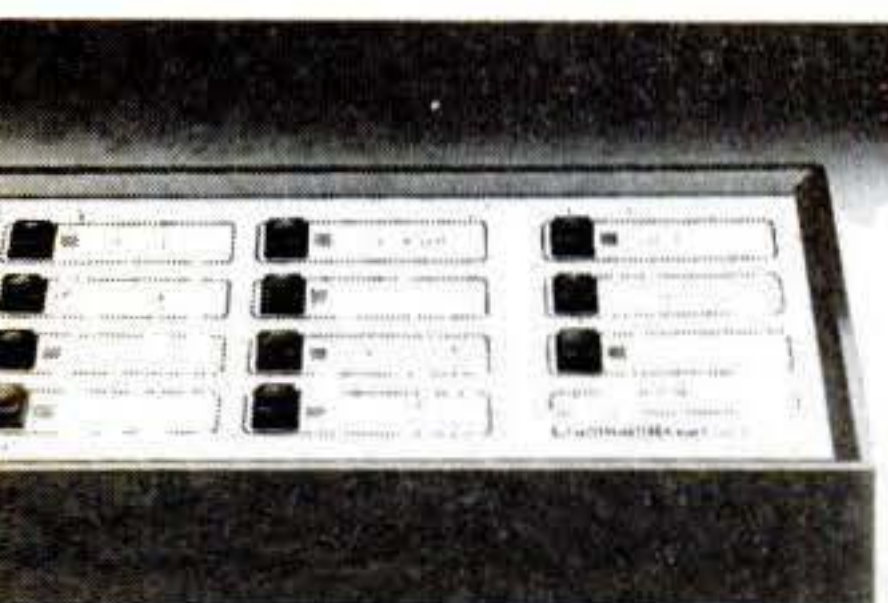
Computer control

Hook your TRS-80 home computer to the Busy Box and you can program the control of appliances through a standard BSR (or Sears) remote control box (ultrasonic model). It's \$105 from Micro-Mint, 917 Midway, Woodmere, N.Y. 11598. Apple II and S-100 versions are also available.



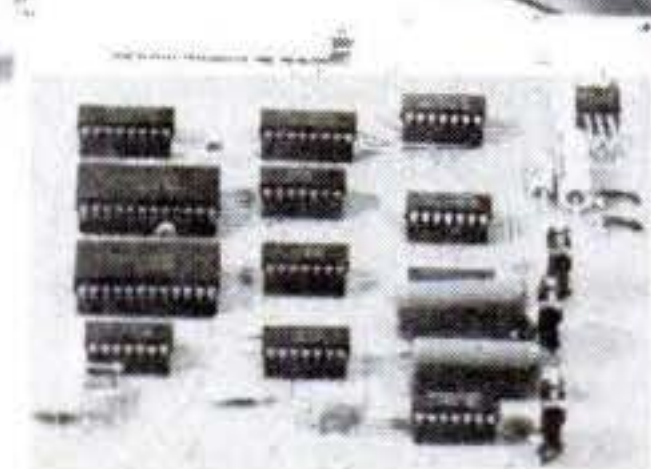
Radar timer

Now you can improve your game scientifically—from baseball to golf—with this Sports Radar from Midex (665 Clyde Ave., Mountain View, Calif. 94043). Aim it at tennis balls, skiers, hockey pucks—the digital display shows you any speed between 20 and 150 mph. \$150.



Two-way remote

Push the buttons on this transmitter, and it sends signals through your house wiring to receiver modules that turn on up to 10 appliances. Receivers then send signals back to report each on/off status. Starter kit: \$120 from C.E.S., 10383 Los Alamitos Blvd., Los Alamitos, Calif.



What's New FOR YOUR CAR

BY ED JACOBS



Digital analyzer

The Heathkit CM-1550 engine analyzer can measure dwell, rpm's, DC voltage, resistance, and DC current. It uses a large, liquid-crystal display for all functions, and has an inductive pickup for rpm's. Kit price: \$94.75, ppd. Heath Co., Benton Harbor, Mich. 49022.

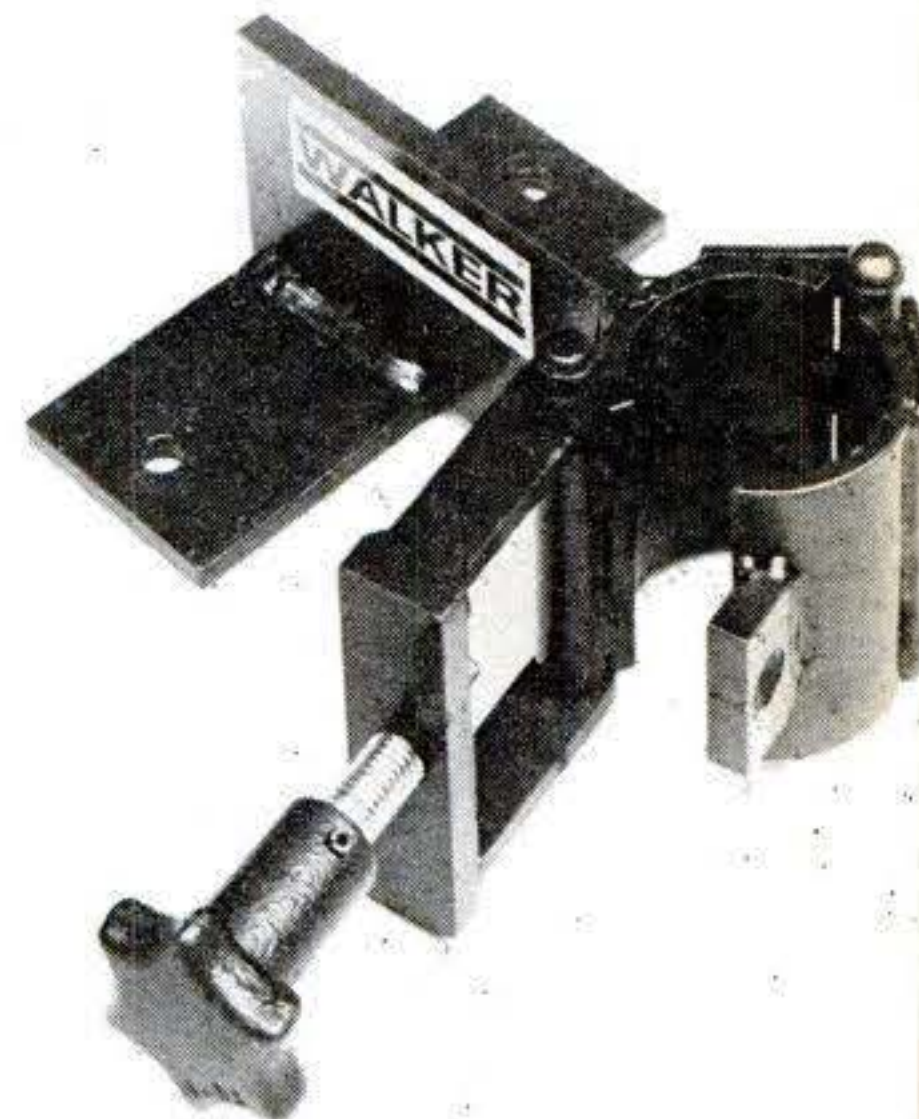
Cruise control

Radatron Cruise Sentry 2 is a do-it-yourself cruise control for either automatic- or manual-transmission cars that don't come with a factory-installed unit. Complete kit costs \$129.95. Radatron Corp., 2424 Niagara Falls Blvd., N. Tonawanda, N.Y. 14120.



Strut tools

Walker's MacPherson-strut spring compressor (top right) and strut vise (below right) for do-it-yourselfers let you work on both domestic- and foreign-made struts, on or off the car. Spring compressor and vise are available at local auto-parts stores.



RV leveler

Parked on a slope? Slip Desmo Caralevel tapered wedges under the low wheels, slowly drive up onto them until your RV is level, and then chock each leveler. Coleman Products Div., Desmo Ltd., Pennett Trading Estate, Brierley Hill, West Midlands DY6 7NW, England.



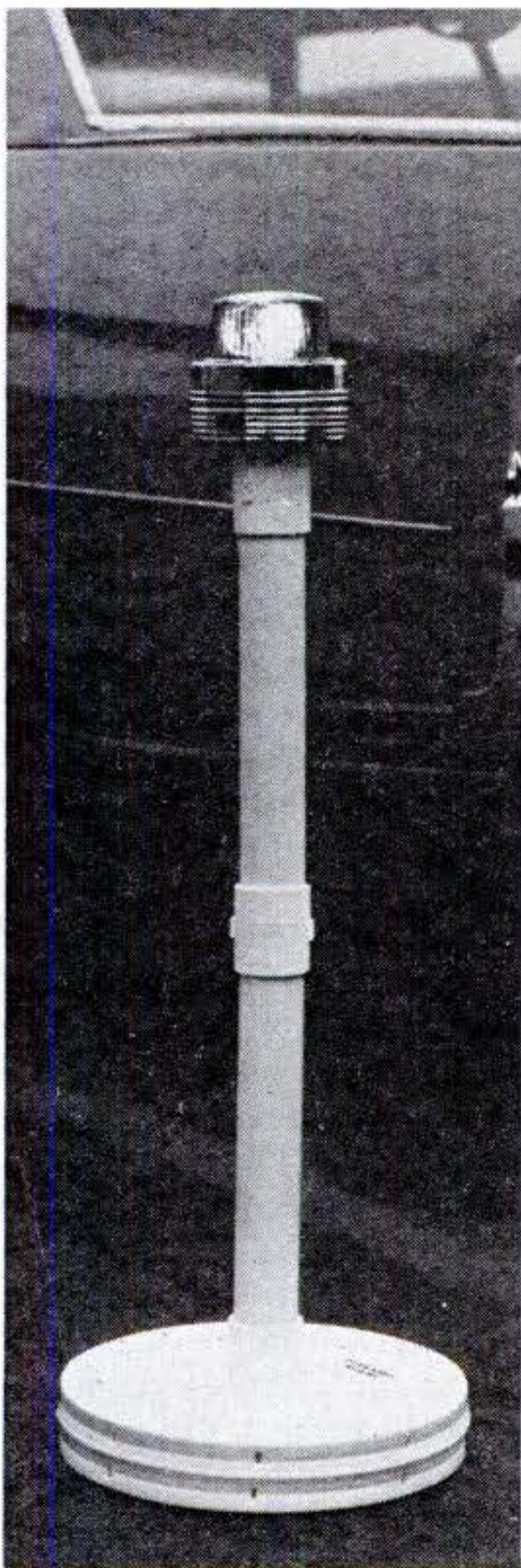
Heat seat

Multi-stranded wiring in this foam-padded seat cushion provides heat to soothe aching muscles on long trips, or to warm the seat quickly in winter. It's powered from the cigarette lighter. Afreur Seafair Ltd., 11 W. Halkin St., London SW1X 8JL, England.



Hazard warning

The rotating amber light on Hazard Alert can be seen 1000 ft. away, and the unit can withstand 50-mph winds, according to Safe-T-Signal, Inc., 1304 S. Fairview, Park Ridge, Ill. 60068. It uses three "D" batteries, comes with its own carrying case, costs \$15.95, ppd.



Aluminum V8's

Mercedes' new generation of lightweight engines



By E. F. LINDSLEY

STUTTGART, WEST GERMANY

The inspection station is a quiet oasis on the humming engine production line at Mercedes-Benz. As I watched, a gleaming, freshly machined V8 cylinder block was eased onto a roll-over stand, and an inspector carefully focused a microscope on one of the mirror-finished cylinder bores. He peered critically through the lens for a few moments, nodded, and beckoned to my guide, Hans Strauber, project engineer for light-metal engines.

Hans studied the image (above) and said something in German. The inspector quickly mounted an instant camera, snapped the shutter, and seconds later handed me the finished print (inset). I examined it and then looked through the scope. Both views resembled a dried-out mud flat seen from 10,000 ft., with innumerable tiny islands separated by minute channels. Engineer Strauber explained, "The islands are actually crystals of silicon to resist wear; the channels act to retain oil."

I'd asked to visit this plant because I wanted to see how Daimler-Benz had

solved the traditional problems of aluminum engines. In particular, I wanted to learn its secrets for running the pistons directly in the aluminum bores, how it kept the aluminum block from distorting under engine heat, and how it managed to get and keep the crankshaft bores straight and true.

The two V8 engines I saw being built are for the new Mercedes S-cars, dedicated to improving gas mileage by at least 10 percent. Using aluminum cuts 45 kg. (100 lbs.) from the 215-hp, 3.8-liter engine, and 50 kg. (110 lbs.) from the five-liter, 237-hp engine. In addition to the engine block, aluminum is used for cylinder heads, rocker covers, oil pan, manifolds, and many small parts. Such engines have been running very successfully for several years, without fanfare, but only in Europe.

Super-strength alloy

I could see how the silicon-crystal islands and thousands of minute oil channels in the cylinder bores might be a good running surface—but, still, aluminum? What about durability? Strauber understood my misgivings.

He pointed out that, except for lightness, this alloy in no way resembles the familiar soft aluminum. It contains up to 15 percent silicon, and is so tough that it can be machined only with diamond tools. After machining, an etching process leaves the hard, wear-resistant islands of silicon and produces the oil channels that meander among the crystals.

Tricky machining

But this super-tough metal is not without its matching problems in areas other than the cylinders. As is usual in aluminum-block engines, the main bearing caps are iron alloy for added strength. But problems arise in trying to machine their five bores in perfect alignment, sized to within a few ten-thousandths of an inch, with materials of differing hardness and machining characteristics. Every half-revolution the cutting tool engages first iron and then aluminum. You might compare it to gluing a block of hard maple to a block of soft pine, then trying to drill an accurate hole dead-center on the split line. The Mercedes solution is to hone the bearing-cap bores to size. I counted 37 strokes as the needle on the built-in air gauge slowly edged toward the red mark that signified the precise diameter. Herr Strauber frowned a bit and muttered, "The honing action is too slow."

He also described how they'd analyzed what had gone wrong with other aluminum engines. One troublesome area had been distortion from heat. Aluminum expands about three times as much as iron or steel when heated. Mercedes designed the water passages very carefully to combat this. Most importantly, the cylinders have a closed upper deck that also ties them together for better gasket sealing.

Old-fashioned assembly

Although I was impressed by the advanced engineering and metallurgy, it was nice to see that assembly is still done very much the old-fashioned way. I watched careful washing, wiping down, and fingertip inspection of each crankshaft for burrs before it was seated in the bearings. The procedure was well paced but not hurried. In a few locations, a battery of power-driven wrenches ran down several bolts at a time, but this was always followed up by precise tightening with a hand torque wrench.

Does it all pay off—the engineering, metallurgy, machining techniques, and care in assembly? Later on, when I was driving these cars, the smoothness, quietness, and performance they exhibited seemed to prove that it did.

Home-improvement ideas

The time's at hand to plan spring projects toward an at-home summer. With travel costs soaring, most of us will be sticking closer to our own backyards this year. By preparing for home activities now, you can turn this limitation into your best summer yet.

The pages that follow contain both our Spring Home Improvement and semi-annual Home Hardware sections. Some of the highlights are shown below and listed at the left.

DECKS and ACCESSORIES

- **Add-on decks** transform two typical backyards—one stepped up from ground level, the other outside a second-story bedroom. Also: plans for slatted accessories—seats, planters, tote trays and magazine rack.

- **Vinyl gutter systems** now come in a choice of styles and shades to match any house—and we've found three of them easier to install than earlier systems of PVC or metal.

- **Burglarproof your home** with the latest in security hardware. Stronger, new-model entry locks are a good investment, combined with low-cost items you can install yourself.

- **With an add-on screen porch** you won't miss summer—and with our plans and tips, it won't take all summer to build.

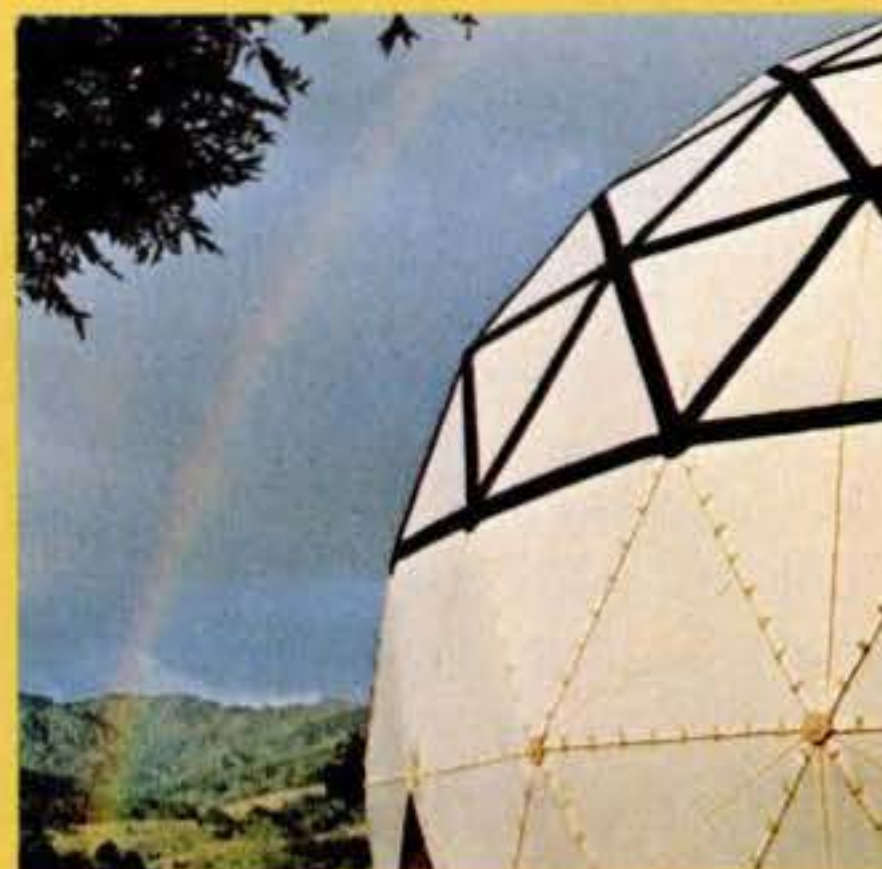
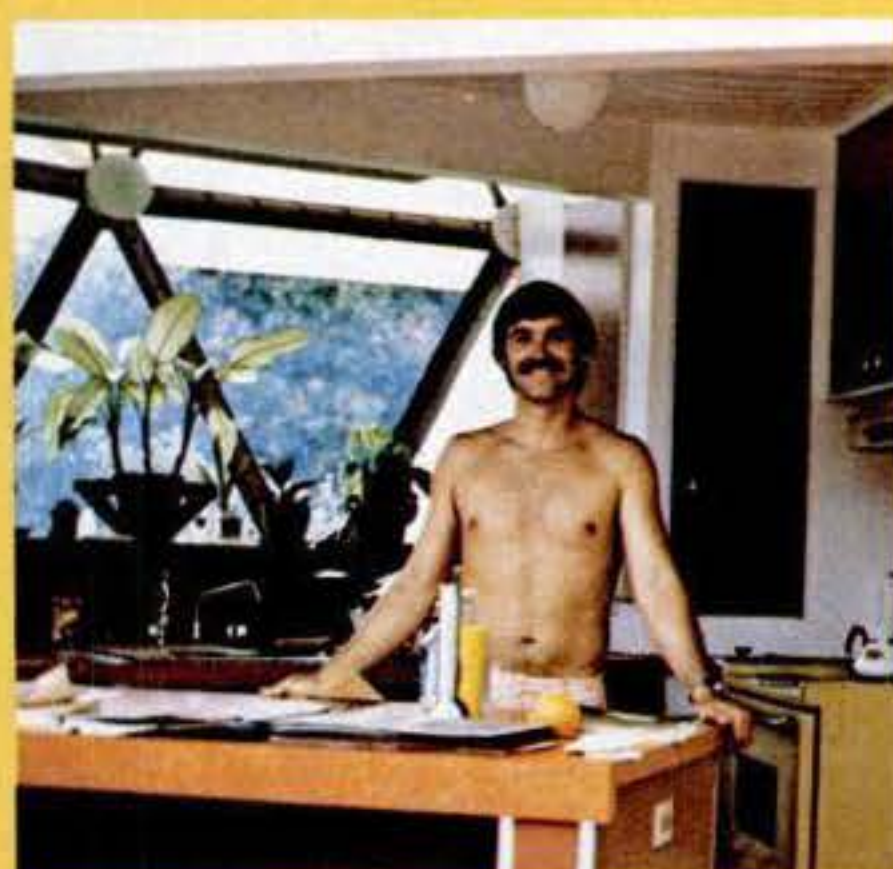
- **To announce** our second FRP contest we offer—on page 127—some near-winners from last year's. One more is the dome home, shown inside and out, below. Designer Tom Kloss (in kitchen) built it on Kauai, Hawaii's "garden isle."



FRP PROJECTS



SPRING
Home-
improvement
ideas



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Two backyard decks

built to last

Ground level, or attached at second story, decks are exposed to heavy weather. Use treated lumber

By **RICHARD STEPLER**

GROUND-LEVEL DECK PHOTOS
BY KEITH SCOTT MORTON

SECOND-STORY DECK PHOTOS
BY JULIUS SPEDALE

Almost no project adds as much enjoyment to outdoor living as a deck. We show you two versions on these pages:

- A second-story private sun space

Continued

The builder of this tract house offered a second-story deck as a costly option; the homeowner opted to build an irregularly shaped deck with cantilevered railing atop the flat roof of first-floor extension himself. (Construction photos on page 121.)





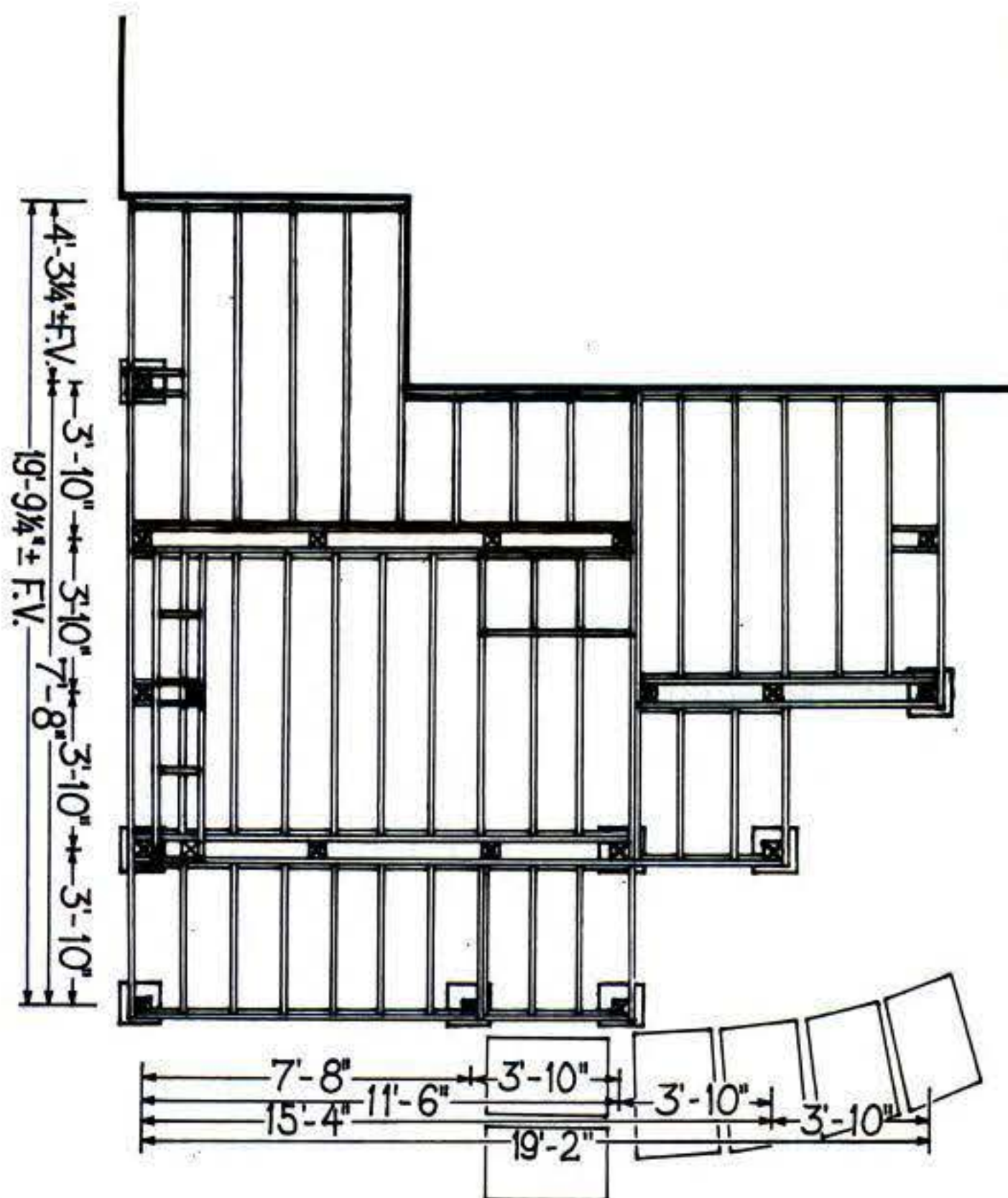
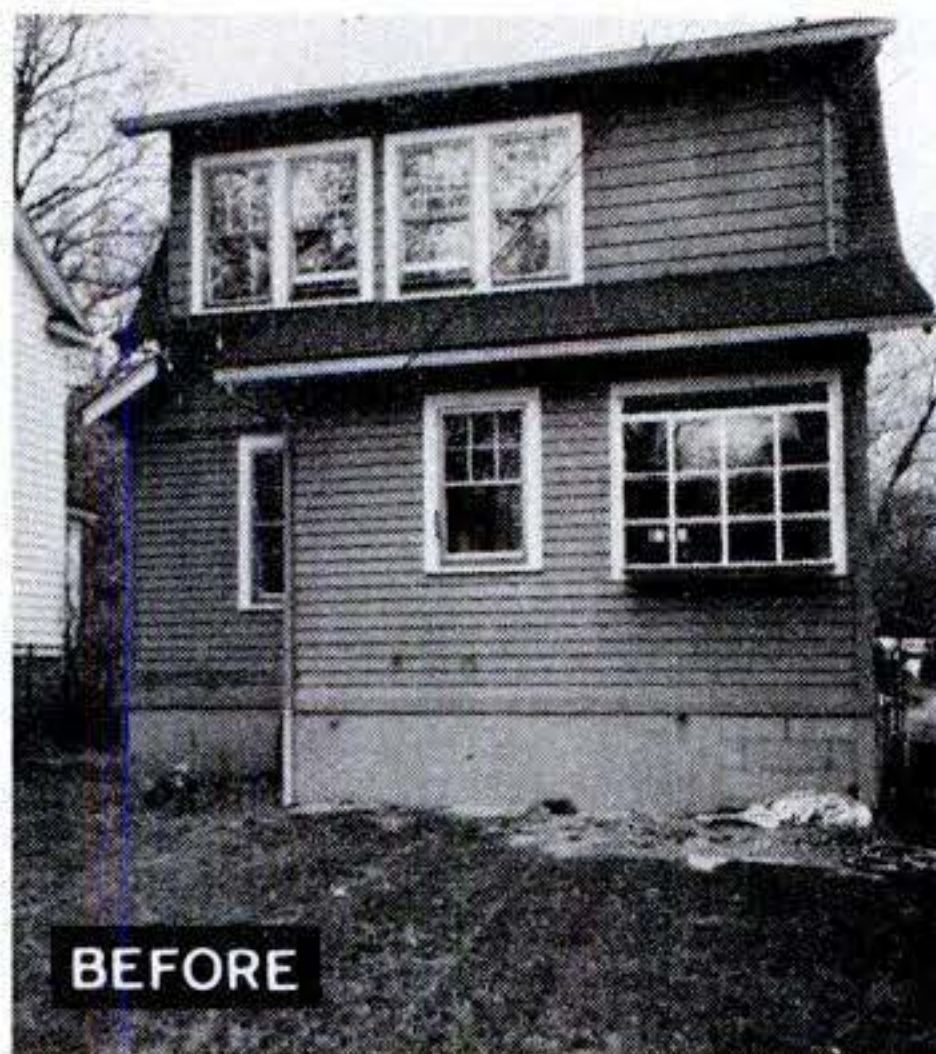
Deck at ground level "steps down" to the backyard of this older home in stages, providing areas for barbecuing, dining, entertaining, or relaxing. Grommeted canvas panels are for wind shielding, as well as privacy; they're removable for winter stor-



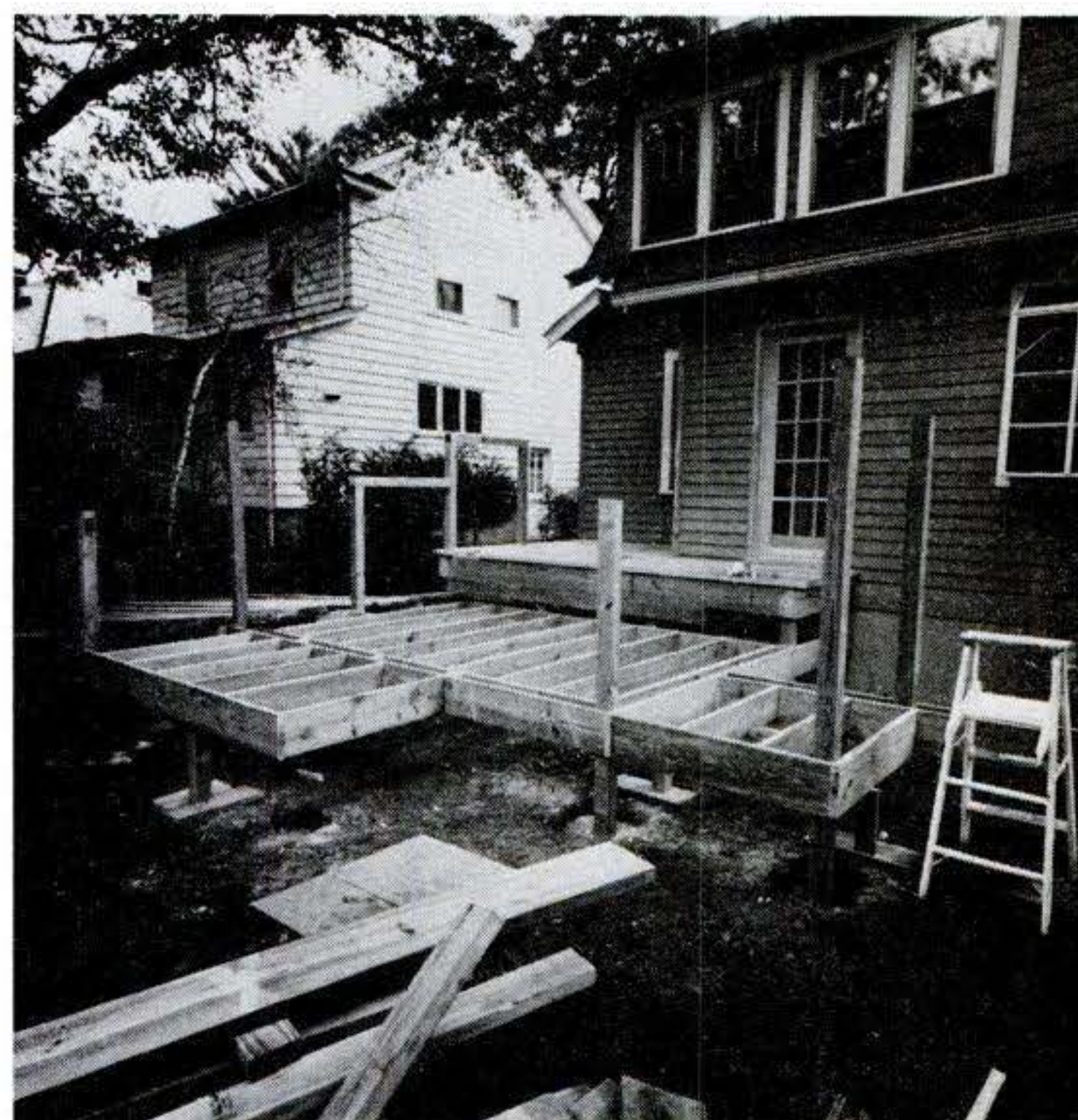
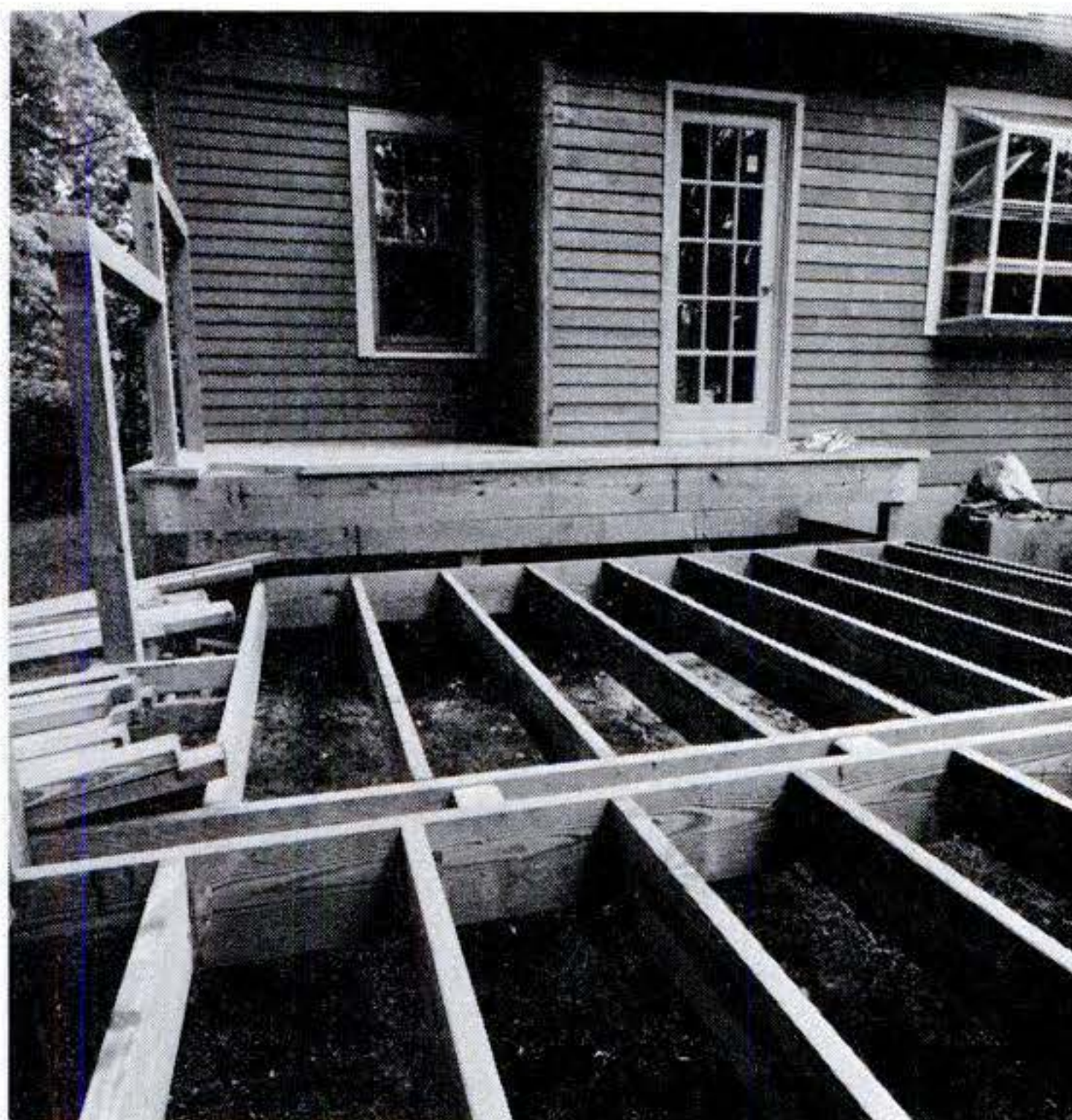
age. While this deck was designed for a specific house, it is modular in construction and can be adapted to other homes and locations. See page 122 for how to build the deck accessories shown: table, stools, planters, trays, and magazine rack.



How to build the ground-level deck



Multi-level deck is constructed in modules; highest level is same height as first floor of home. Support framing for deck's lower level is shown almost completed in the photos below. All members are 2×8's, 16 inches on center. The 4×4 posts are set in concrete below the frost line. Where they double as framing for the canvas panels, they extend above deck height. (Posts were all trimmed to the same height in lower right photo.)



for a master bedroom built on a flat roof (color photo, page 117).

• A multi-level deck attached to a home at ground level (color photos on facing page).

Neither of these decks is beyond the skills of the average home handyman. The second-story deck's dimensions were dictated by an existing first-floor extension (that's why we show no plan; you could build your own variation, however, using our techniques). Ours measures 38½ feet long overall, with a 13-foot section 4½ feet wide, an 8½-foot-long portion only 2¼ feet wide, and a six-sided projection up to 10 feet wide. Because of the deck's rather long and narrow proportions, designer Larry Adler chose a railing

that is cantilevered outward for a less confined feeling. And because it is a second-story deck, the railing is extra high for added protection. Construction of this deck is straightforward, primarily using 2×6 lumber (see step-by-step photos on page 121 for more information).

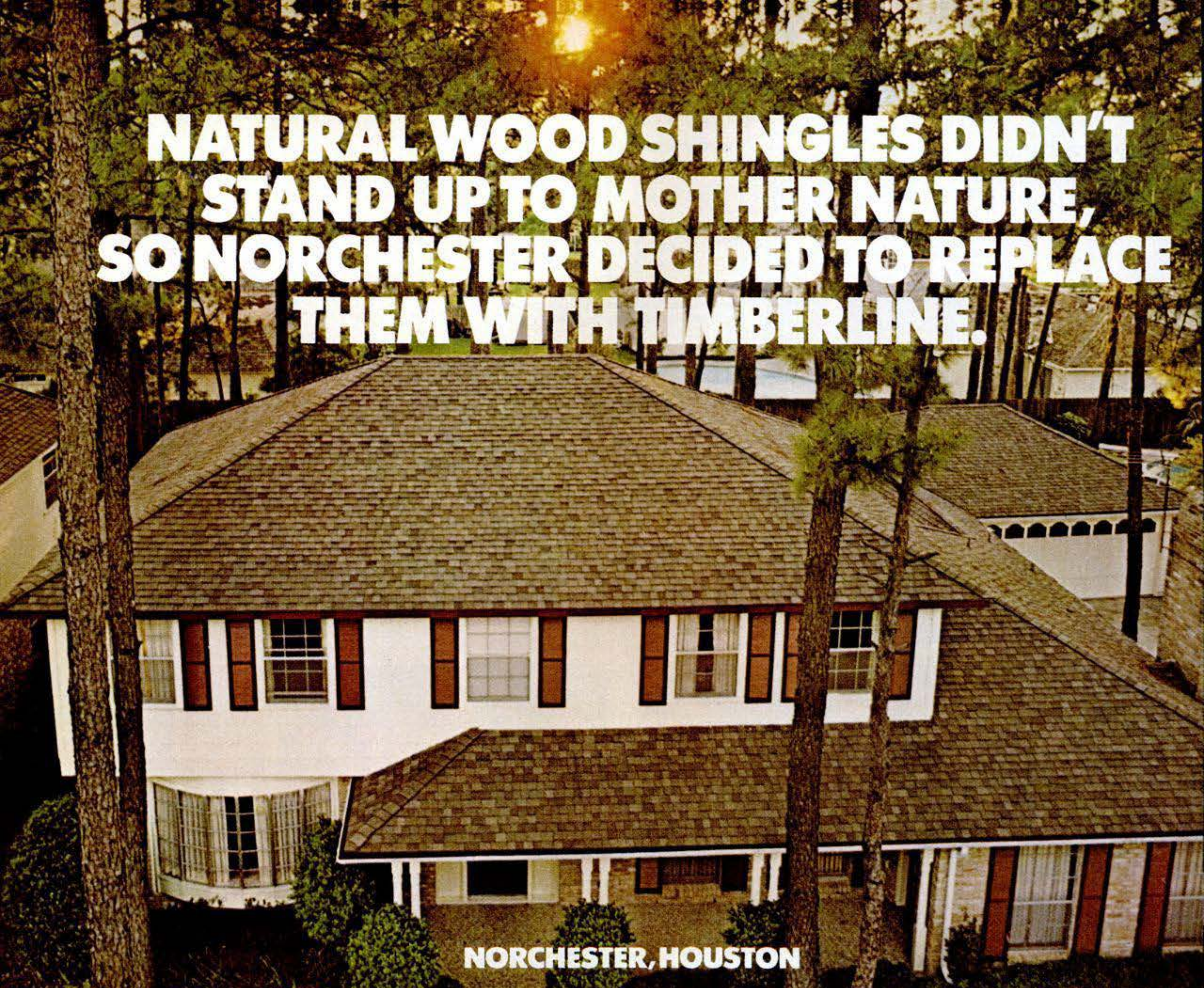
The ground-level deck (page 118 and above) is more elaborate. It organizes outdoor activities on two levels: Near the back door (adjacent to and on the same level as the home's kitchen) is the barbecue area. Two steps down are spaces for dining, sunning, or relaxing. Colorful canvas panels provide wind and privacy screening. They're lashed in their frames with nylon cord through corner grommets

and screw eyes. After the deck season, next fall, you detach the canvas and roll it for storage. The colors will stay fresh for years with only seasonal exposure.

To make sure a deck is a *lasting* improvement to your home, you're wise to use lumber that's pressure-treated for decay and rot resistance. Both decks shown are built with Koppers' Wolmanized Outdoor Wood. This lumber is treated with a chemical preservative to "indefinitely resist rot, decay, and attack by wood-destroying organisms and insects, including termites."

Outdoor Wood can be stained, varnished, painted, or simply left to

Continued



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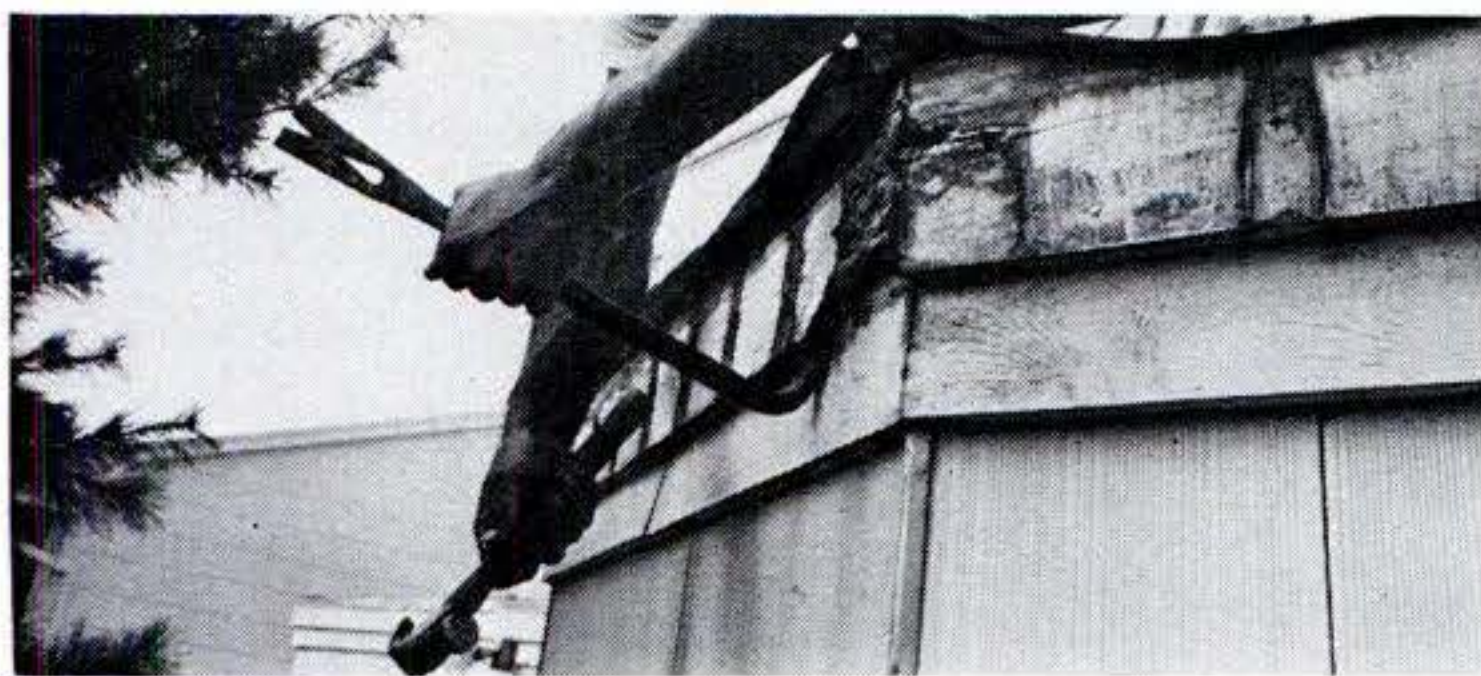


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*See GAF "Limited Warranty Asphalt Shingles" for specific details of coverage on Timberline. This warranty is available free by writing to the GAF Corporation, Building Products, Dept. T979, Box 1121, Radio City Station, New York, 10011. ©1980 GAF Corp.

How to build the second-story deck



First step in construction of second-story deck is the removal of rotted fascia board from the edge of the flat roof, using a crowbar. It is replaced with pressure-treated Outdoor Wood.



Deck surface of 2x6's is fastened to support boards with 10d galvanized nails. For better appearance and stronger structure, stagger them so ends don't line up on same crosspiece.



Railing support posts are nailed to the new fascia board, two 10d galvanized nails per post. They're also toe-nailed to deck surface from both sides, again using two 10d nails.



Support posts are spaced two feet on center: Measure them at the top and the bottom. The irregular shape of the deck made positioning the posts important for a neat appearance.

weather to a rustic gray. (The ground-level deck was treated with one brush coat of McClosky gray bleaching oil.) Don't burn leftover scraps of Wolmanized wood, however, either indoors or out.

Some general tips on decks:

- Decking should be installed with the bark side up (annual growth rings at the ends of boards should curve

downward if positioned correctly).

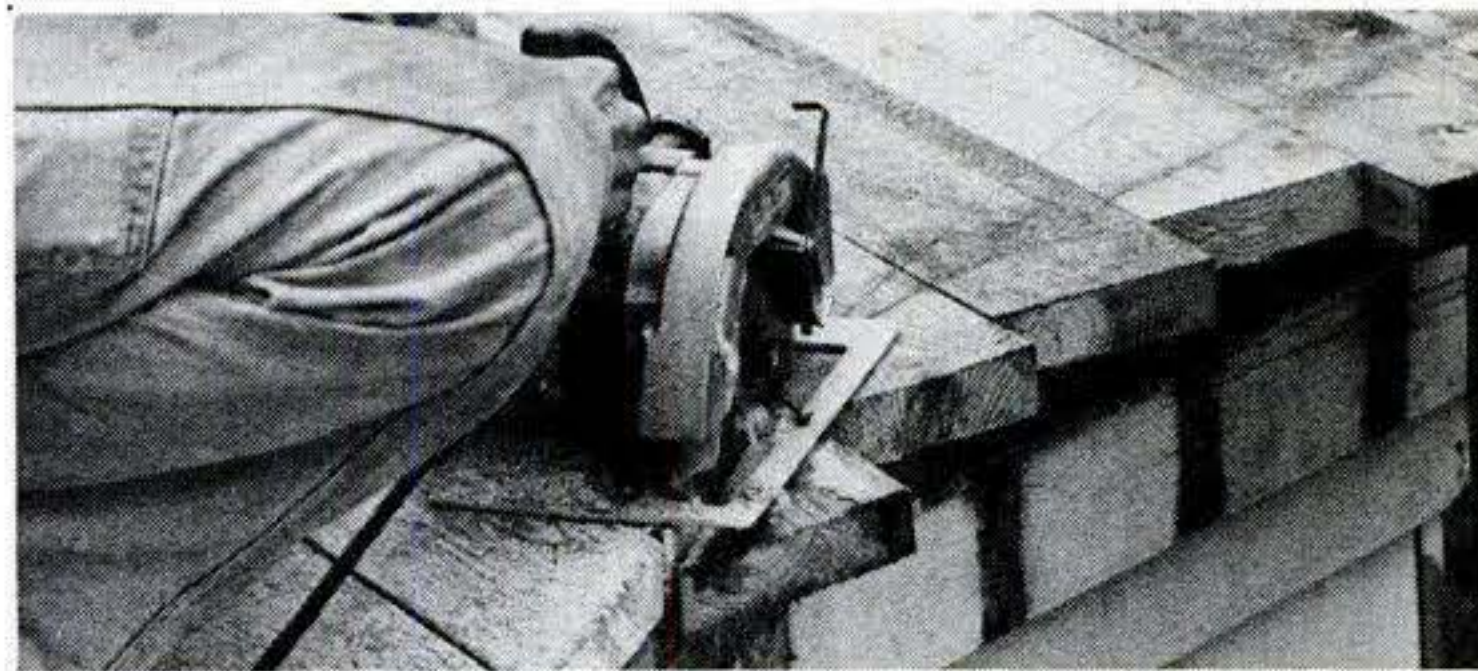
- Space deck boards $\frac{1}{4}$ – $\frac{1}{2}$ inch apart to allow for expansion of wood, and proper drainage.

- Bevel ends of exposed upright posts to a 30- to 45-degree angle to improve drainage and lessen the chance of splitting due to moisture absorption.

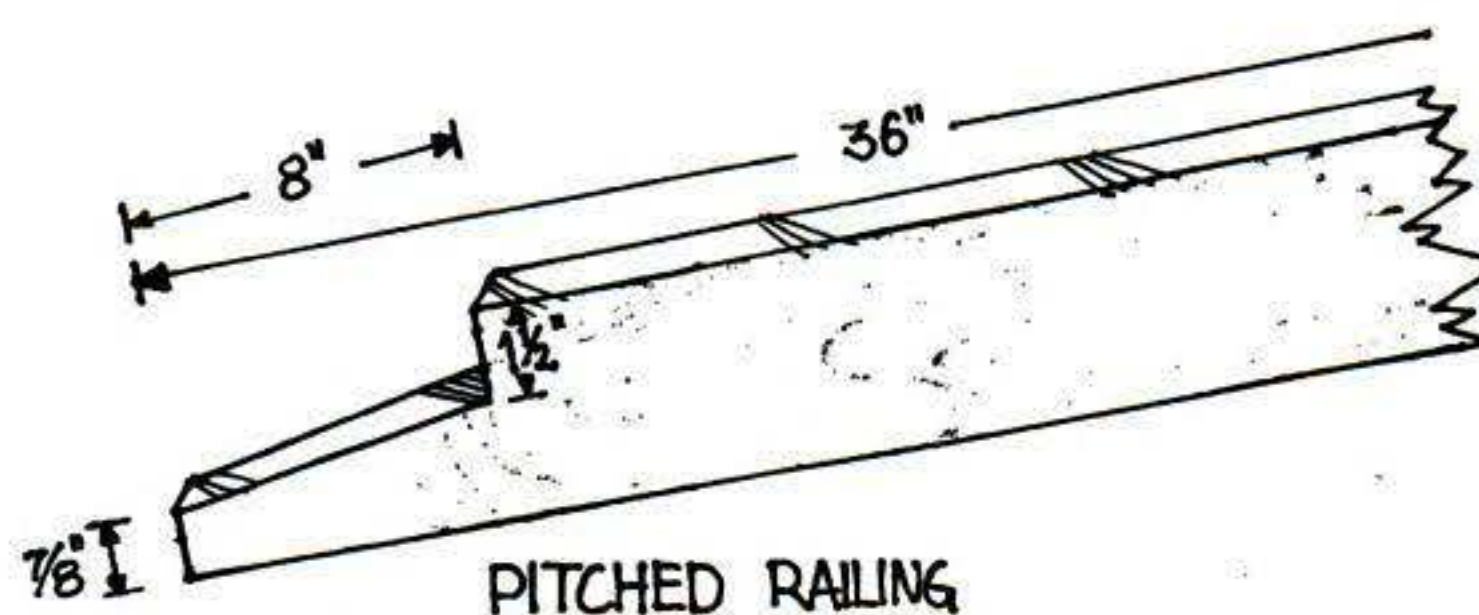
- Use galvanized or rustproof



Next, after roof is resurfaced with tar and roll roofing, 2x6's are placed 16 inches on center across the roof. To avoid leaks, they aren't nailed; the weight of the deck keeps them in place.



Deck edge is trimmed with a circular saw, leaving a three-inch overhang for a "shadow effect." Chalk line ensures a straight cut. Note $\frac{1}{4}$ -inch gap between boards to allow for expansion.



Railing is pitched outward to give this rather long and narrow deck (38 feet long by as little as 2 1/4 feet wide) more elbow room. The posts are notched as shown in the drawing.



Fasten 2x6 top railing to each support post with two 10d galvanized nails. Mitered ends were cut as needed to match contours of deck. To come: 1x3 intermediate rails (see color photo).

nails, framing connectors, bolts, and screws (rust streaks cause unsightly stains).

- Predrill holes near board ends to prevent splitting. With dense or brittle wood, blunt all nails with a hammer.

- Use annular or spiral-shanked nails for maximum holding power.

Continued

Backyard decks

[Continued]

Hammering nails at a slight angle toward each other also gives better holding power.

- Always nail thinner deck members to thicker ones.

FOR FURTHER READING

"How to Build a Deck"; 22-page booklet costs \$1 from Koppers Co., 1900 Koppers Bldg., Pittsburgh PA 15222.

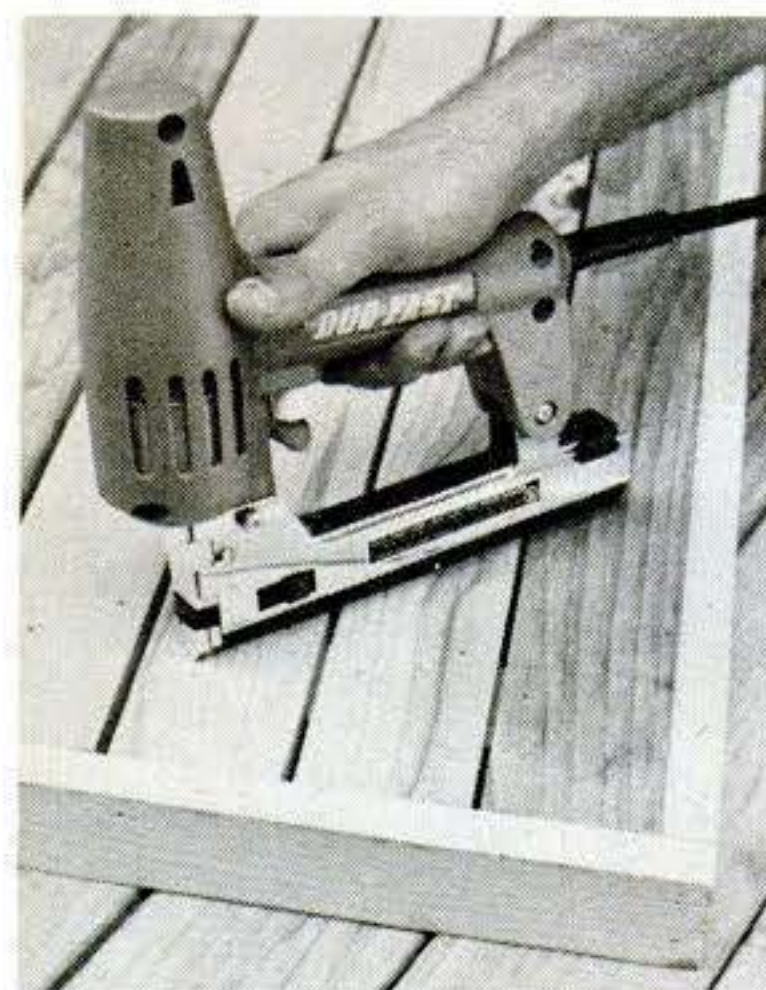
SECOND-STORY DECK CREDIT

Expert advice on flat-roof treatment: Vinnie Fava of All-Weather Home Repair, 201 Maple Ave., E. Meadow, NY 11554.

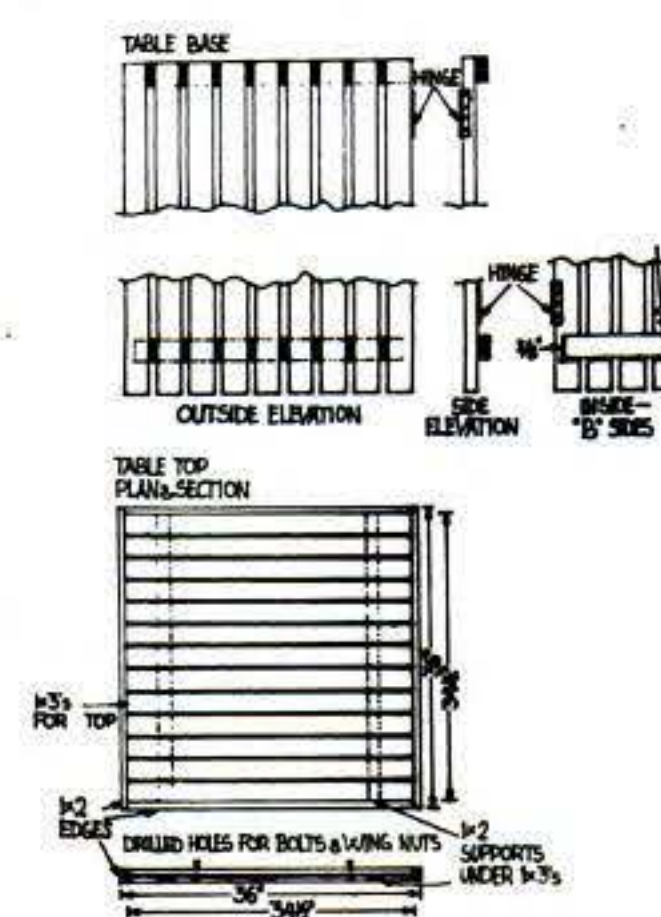
MULTI-LEVEL DECK CREDITS

Architect: Dirk Kramer. Accessories design: Allen Scruggs and Douglas Myers. Wolmanized lumber: Koppers Co. (address at left). Joist hangers: Teco (5530 Wisconsin Ave., Washington, D.C.). Canvas: American Canvas Institute (10 Beech St., Berea, Ohio). Electric brad nailer and staple gun: Duo-Fast. Exterior lighting: Halo, div. of McGraw-Edison. Barbecue: Weber Kettle.

You can build these stylish deck accessories

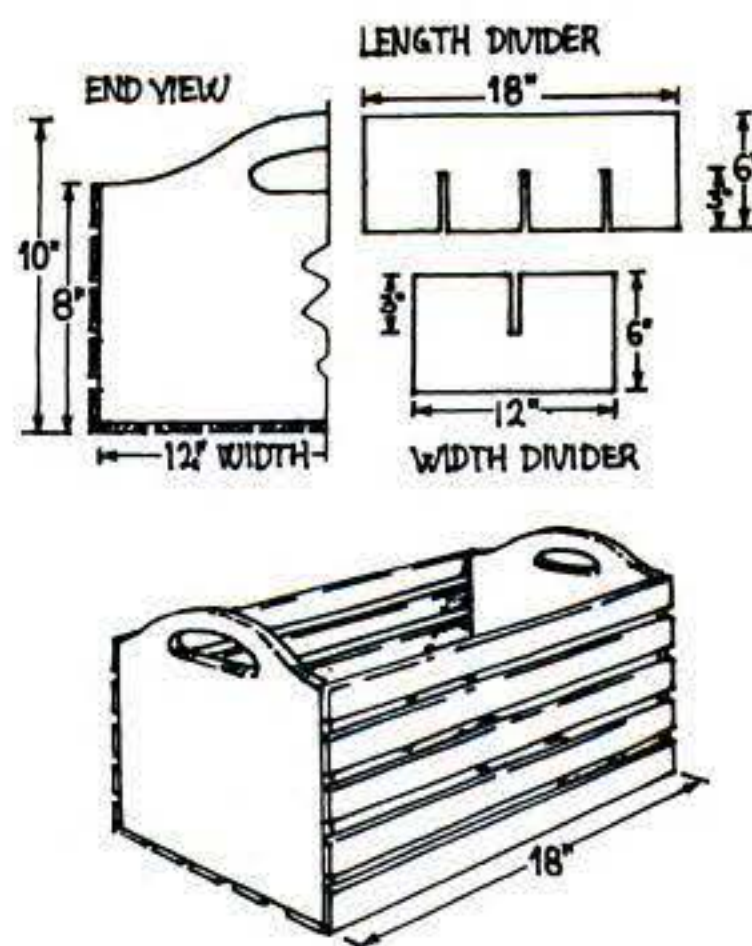
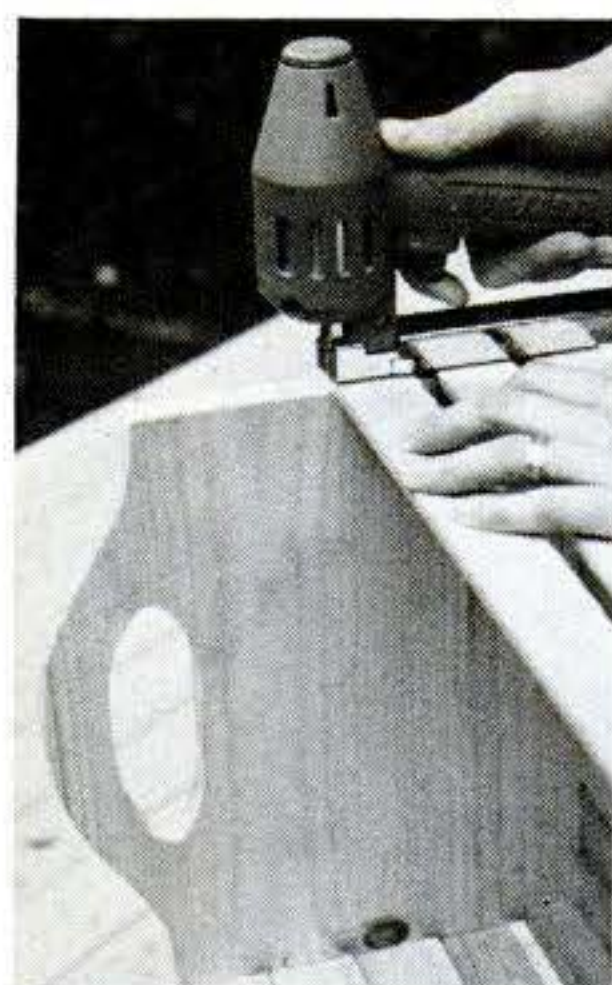


Knock-down table



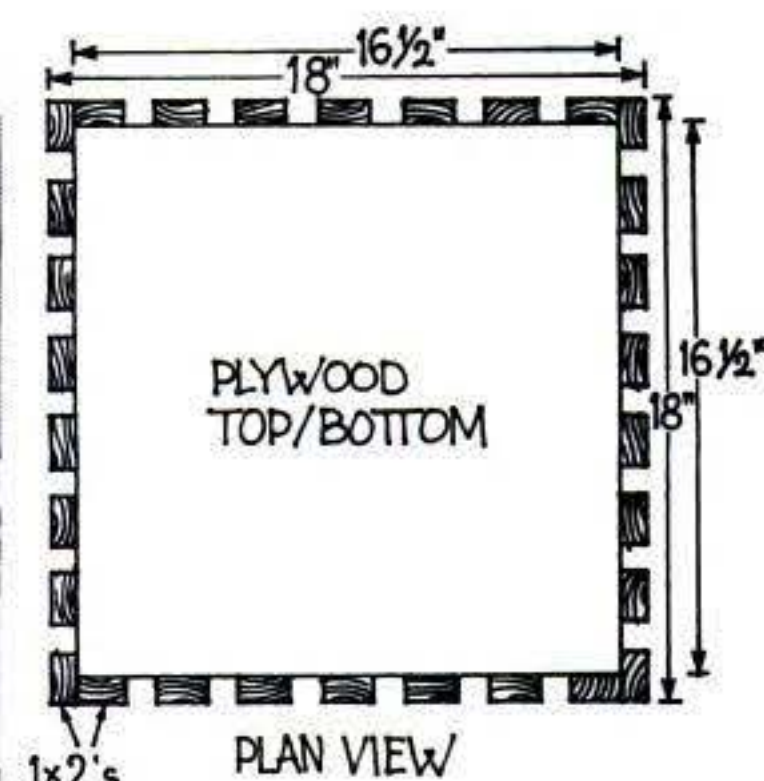
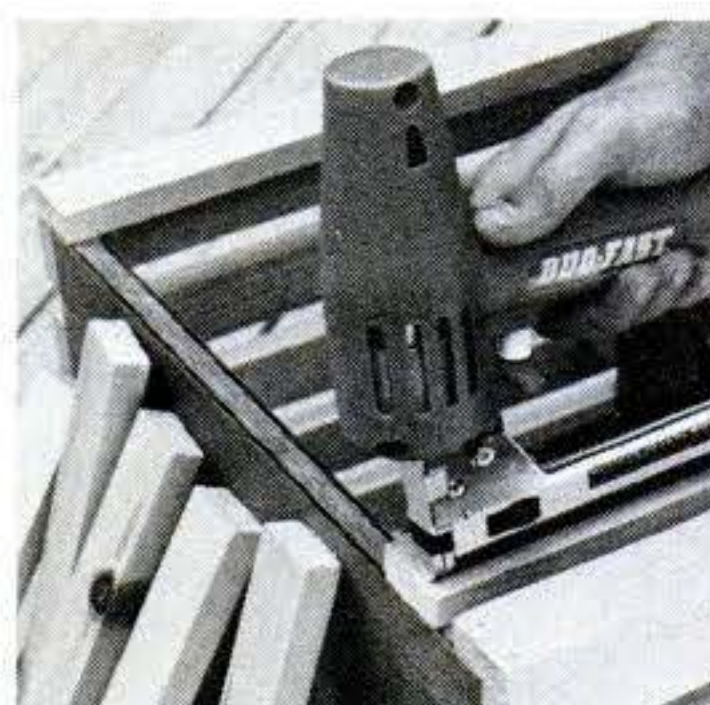
Deck table consists of two 36" square tops, each resting on a 29 1/4"-high folding base. Assemble with white glue and 1 1/4" brads; an electric brad nailer (photo) speeds the job. For each top, you'll need two 36"-long 1x2's, four 34 1/2"-long 1x2's, and 13 34 1/2"-long 1x3's. Build a 36" square frame with two 36" and two 34 1/2" 1x2's, placing two 34 1/2" 1x2's about four inches from the outside edges, flush with the frame's bottom. The 13 1x3's fit into the frame with small spaces between each one. Tops can be joined with bolts and wingnuts to form 6' dining table. For each base, you'll need eight hinges (with removable pins and about 2 1/4" long) and 1x2's: 36 pieces 29 1/4" long, four pieces 17 1/2" long, and four pieces 15 3/4" long. Bases consist of two "A" sides (made from two 17 1/2" and nine 29 1/4" 1x2's) and two "B" sides (made from two 15 3/4" and nine 29 1/4" 1x2's).

Barbecue carrier trays



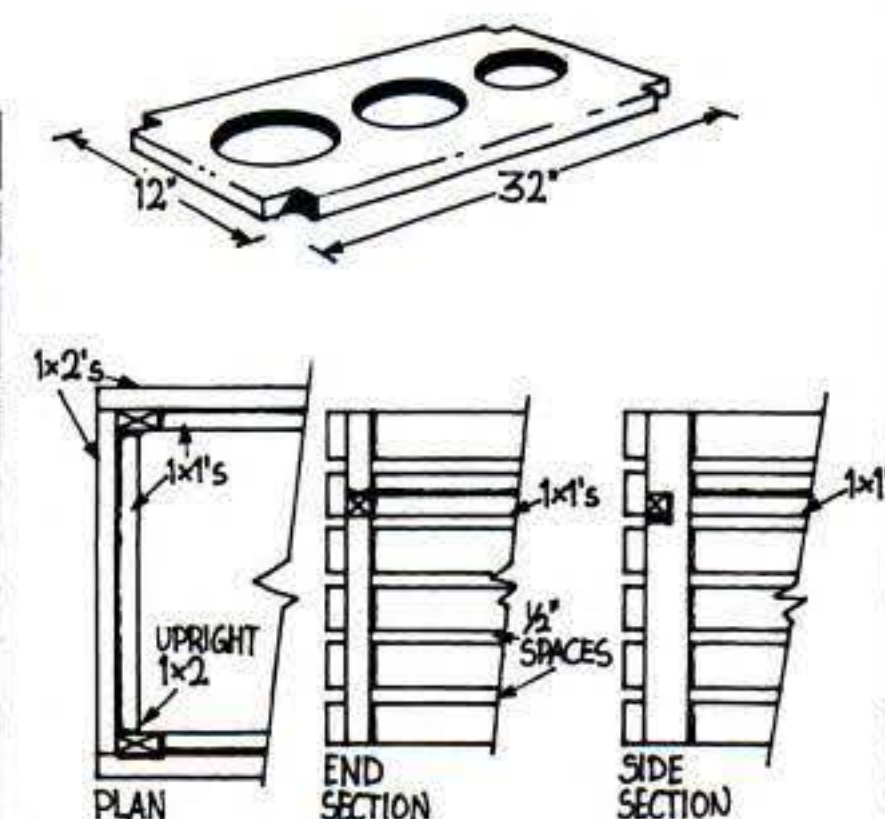
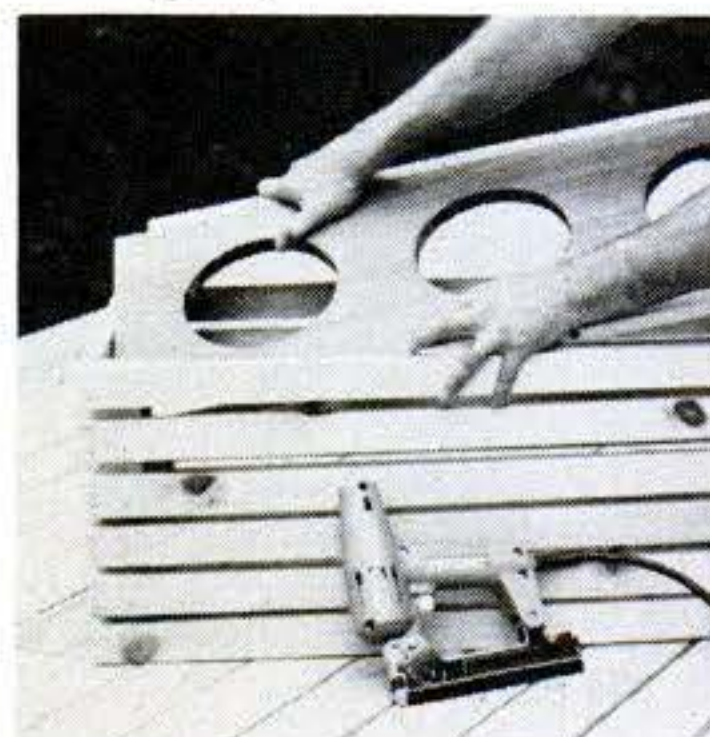
Build these trays and you'll cut the number of trips between kitchen and outdoor barbecue area. Materials needed for each tray: two pieces of 1x12 for the ends, and wood-lath slats cut to the desired length of the tray. For easy assembly, use an electric staple gun and long staples. We built two sizes: a 6"-deep tray for china and flatware; and an 8"-deep tray for bottles. Blanks for smaller-tray ends measure 8" by 12"; clamp them together when you cut the curved top edge and handle cutout. Sixteen 18"-long slats are needed for the smaller tray; space them evenly (about 1/2" apart), using two staples at each end. Blanks for the bottle carrier's ends measure 10" by 12"; this tray requires 18 slats that are 19 1/4" long. The dividers are cut from 1/4" plywood; as shown in the drawing, they provide eight "egg-crate" compartments. Sand and finish with clear satin polyurethane or enamel.

Cube stools



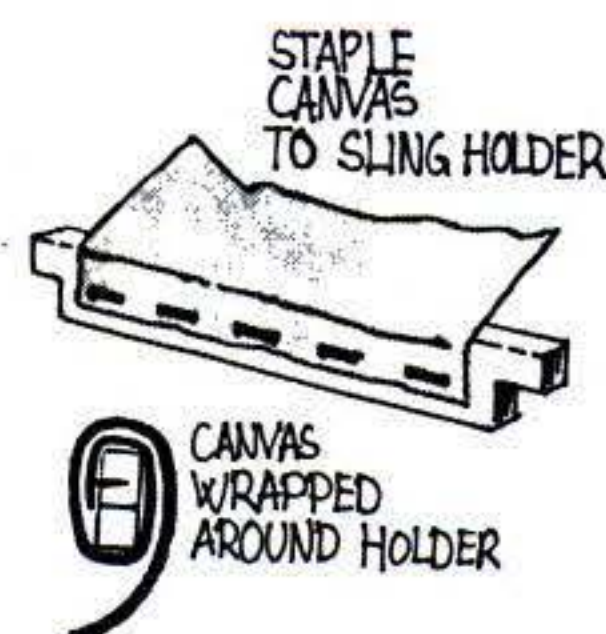
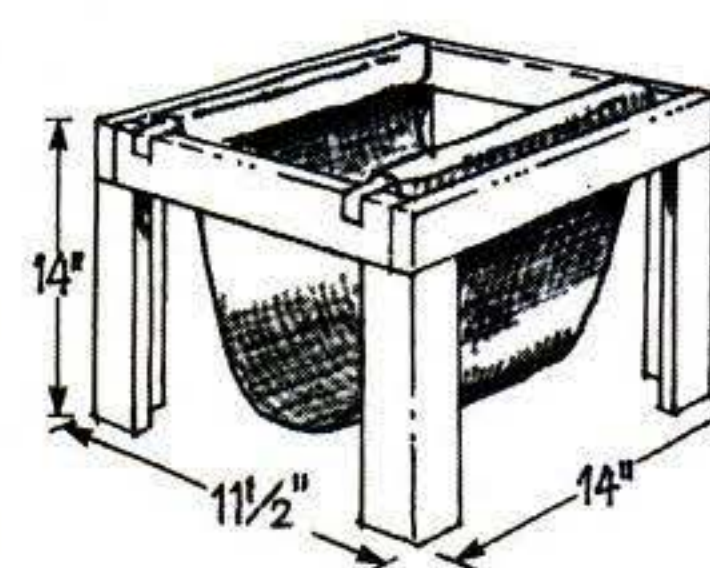
These stools match the table at left. For each you'll need two 16 1/2" squares of exterior grade 3/4" plywood and 30 17"-long 1x2's. Using an electric brad nailer and 1 1/4" brads, nail seven evenly spaced 1x2's to opposite sides of plywood squares. On the other two sides nail eight 1x2's (see drawing). Cushions are made from 16 1/2" squares of 2"-thick foam, covered with canvas. Optional: Velcro strips to hold cushion in place.

Three-pot planter



Planter measures 33 1/2" long, 13 1/2" wide, and 11 1/2" high. You'll need 1x2's (12 33 1/2" long, 12 12" long, and four 11 1/2" long); 1x1's (two 10 1/2" long and two 29" long); and a 12"-by-32" piece of 3/4" exterior-grade plywood. Build box sides as shown in drawing, spacing slats 1/2" apart. Add 1x1's along the bottom edge of the second slat from the top of the planter. Cut out the corners in plywood, as well as three evenly spaced 6"-dia. holes.

Magazine rack



Simple rack keeps your reading material organized. All wood is 1x2: eight 14" long (legs); two 14" long, notched at ends (sling holders); two 12 1/2" long (sides); and two 10" long (ends). The canvas sling measures 15 1/2" by 32"; hem it on all four sides to prevent fraying. Assemble the sides and ends first; then nail the legs to the outside of the frame (see drawing and color photo). Wrapping canvas around holders hides the staples.



SPRING
Home-
Improvement
Ideas

You don't have to go ogee. Install-it-yourself systems now offer other shapes

By AL LEES

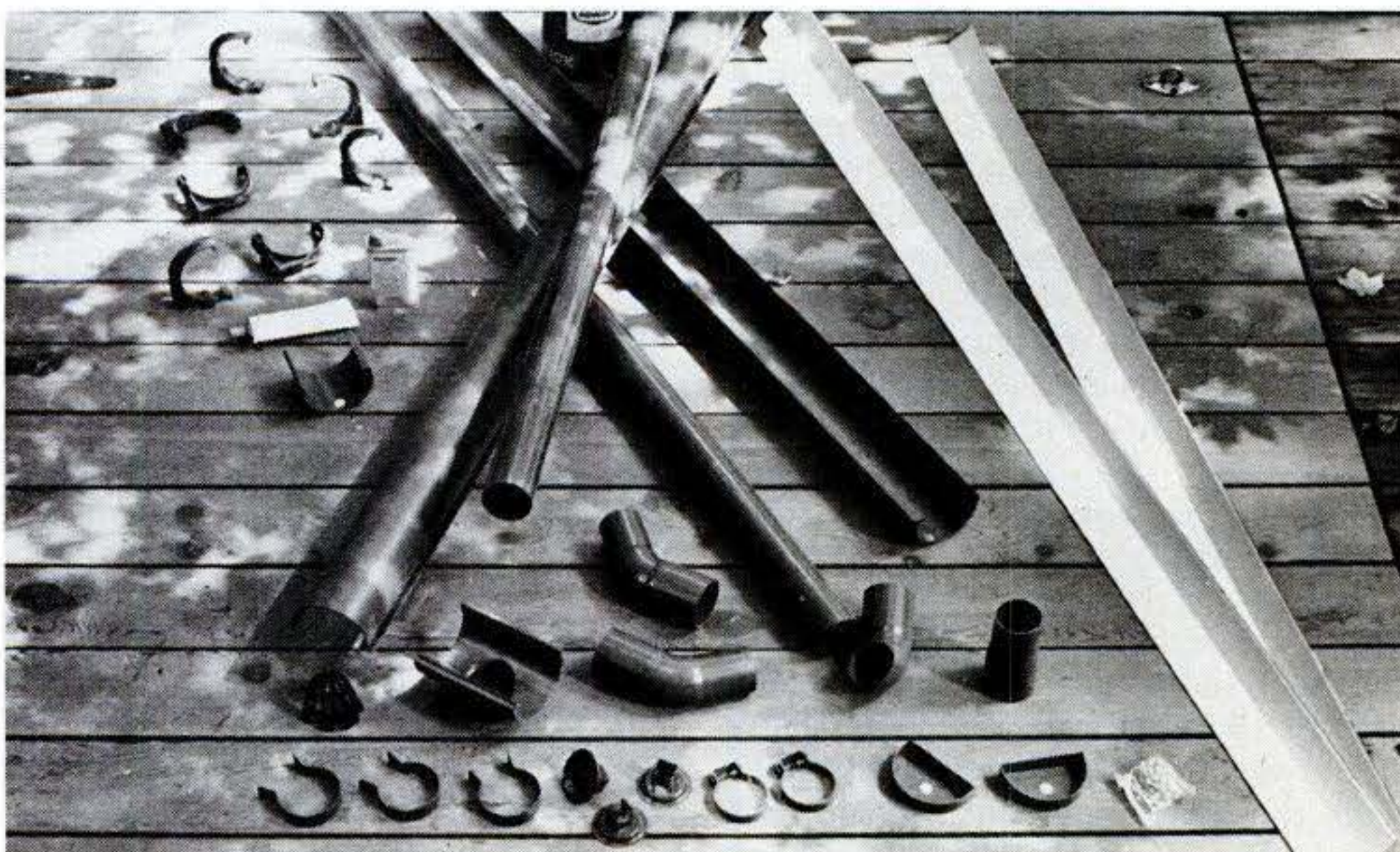
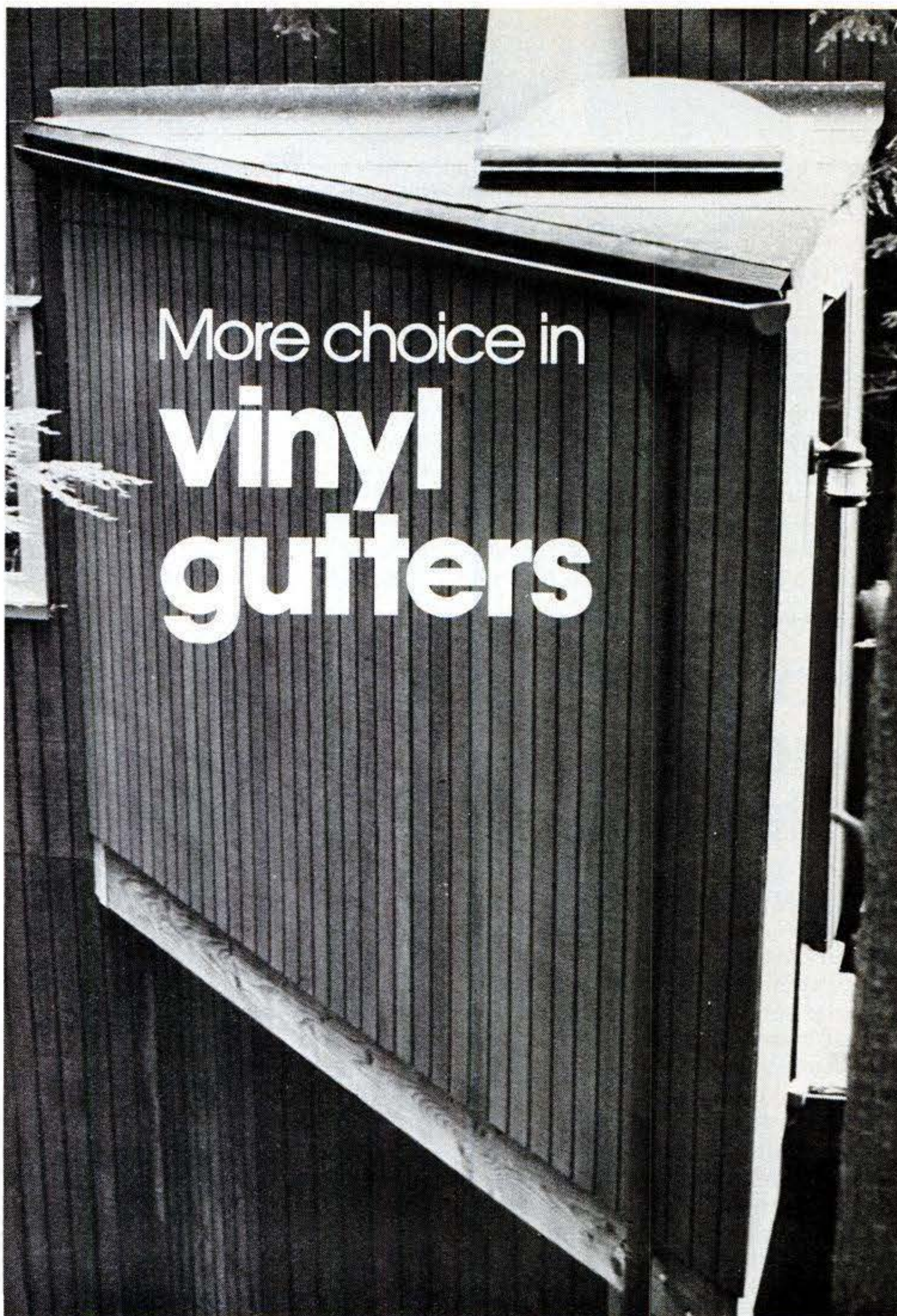
Until now, you could have vinyl gutters in any color and shape you wanted, as long as you wanted white and ogee. That slanted-S pattern looked most at home with New England clapboards—and *they* were usually white. Chances are, the gutter you bought was made by a New England company, since Bird & Son of Walpole, Mass., has long been the major manufacturer of vinyl building products. (We detailed a Bird & Son gutter installation in our April '78 issue.)

Of course, if your home happened to be of crisp contemporary design, sided in dark wood, you could minimize the intrusive guttering by painting it (latex works best). But since you'd probably chosen the vinyl route so you'd have a no-maintenance system, you may have been reluctant to introduce a potential repainting chore.

The solution's now at hand. The gutter system in my photos at right is designed to bring all the advantages of vinyl to an inconspicuous installation. Note how it virtually disappears on this entry wing of the PS Lockbox test house. It cuts down on bulk by returning to the classic galvanized half-round shape (with tubular downspouts), and you can order it in the charcoal gray shown here. Called Plastmo, it's only one of several new PVC systems that broaden your choice in DIY guttering. (See following article for two more.)

Plastmo is a very international system: Most of the components shown in the photo were stamped "Made in Denmark," but the plastic leaf cage came from Britain and the label on the can of cleaning fluid (required for cement bonding) read "Made in Canada for Plastmo Ltd." You'll find the address of the U.S. distributor in the list of manufacturers on page 125; write for a color brochure with more thorough step-by-step instructions than I can include on the next page.

Continued



All parts used for installation above are laid out here before assembly: 10-ft. lengths of pipe and gutter, brackets, drop

outlet, downspout rings and anchors, elbows and joint connectors, end caps, leaf basket, cement—and driplet strips.



Lengths of gutter are joined in place by means of snap-on connector sealed against leaks with PVC cement after a cleaning with special solvent.



Mark gutter for downspout connection by using drop outlet as template. Then notch mark out of gutter bottom with V-cut, and cement outlet on.



To mount end cap, you must slot gutter's outer rim $\frac{3}{4}$ " with hacksaw. Parts shown here are white vinyl, though we used charcoal gray for our job.



Apply cement liberally inside cap flanges after solvent-cleaning. Seat cap against end of gutter. Flange fits in slot for leakproof bond.

I availed myself of one of the system's unusual options—those driplet strips. They're just shallow vinyl angles designed for eaves that lack a sufficient overhang to tuck the gutters under. With the wide side of the angle slipped under the bottom course of shingles (or—as in my case—nailed under the edge of roll roofing), the angled side drains runoff down into the

gutter. Since these strips come only in white, I painted the exposed flange.

With this new choice of styles—and at least the start of a choice of colors—I expect vinyl to replace all other gutter materials before long. What homeowner wouldn't vote for a maintenance-free system that ends rusting, leaking, denting, and peeling? Vinyl is clean to work with and there are no

sharp edges to nick or scratch you. All components are lightweight and durable enough to survive dropping—important considerations when you're working from a ladder.

And the systems described below—which don't even need cementing—are even easier to install than the one I chose, though they're available only in white.

Two snap-together systems

By EVAN POWELL

If your eaves are easily accessible and if you've planned your materials purchase wisely, you can probably install one of these new systems in less than half a day. It took me under two hours to put up a 60-foot run with two downspouts. Both systems I experimented with resulted in a neat, premium-quality installation. That's where your labor pays off: By doing the work yourself, you'll probably spend no more than it would cost to have metal gutters installed.

You really can't appreciate these new systems unless you've worked with the adhesive, rivets, or solder of typical gutters. But with the two systems I used—Genova's Raingo and GSW's Snap-Seal—you mount the supports and fittings, then snap the 10-foot gutter sections into position. Each fitting has a vinyl seal that compresses against the gutter and prevents leaks, yet still allows for movement of expansion and contraction at each joint.

Gutter sections come in 10-foot lengths, so it's easy to determine the number you'll need just by measuring your eaves. Estimating the type and number of fittings is more difficult. Ask your dealer for a "schematic" of the system you've chosen—it'll look like the one for Raingo on the next page. Study it well with these basic points in mind; each end of a gutter run will require an end cap; each

length of gutter that does not terminate at a downspout drop or corner will require a coupling ("slip-joint" if you're using Genova, "joiner" in GSW terminology) and support brackets every 24 inches. This boils down to three support brackets and one fitting for each length of gutter. Each turn calls for a corner fitting, inside or out.

Figure one downspout for every 700 square feet of roof area. For the average house, this usually means one downspout for every 30 linear feet of sloped gutter run.

To estimate for downspouts (also in

10-foot sections), measure the vertical drop from the fascia to the ground, from the overhang to the wall, and from the discharge pipe (if used) at the bottom. Each offset requires two elbows and each downspout discharge requires one elbow. Support brackets should be installed whenever lengths of downspout are joined, but the first section of downspout requires two supports and each additional section requires one, as well as one coupling.

Next, prepare the eave for installation. Remove any old gutter hardware and inspect the condition of the fascia



In place, the two systems look much alike. This is Raingo, on author's test house.

board beneath. If there are signs of rot or damage, repair or replace, and apply a fresh coat of paint.

Before you start, use a level to see if the edge of your roof line slopes; it may not be as level as you think, an advantage when installing gutters. You can combine appearance and efficiency by sloping the gutter toward the downspout outlet for good drainage. It should slope about one inch every 30 feet.

Avoid low spots by snapping a chalk line along the fascia as a guide for installing the gutter supports. Mount the gutter low enough so its outer edge is below the extension of the roof line, to avoid trapping or blocking snow and ice runoff.

The brackets space the gutter from the fascia, which allows good air circulation, so rotting should be much less of a problem. This spacing also makes it easier to paint the house trim with the gutter in place.

With fittings and gutter lengths at hand, start at one end and install the first fitting, which will usually be a downspout outlet. This done, attach three brackets to support the first full length of gutter section along the chalk line.

Here's where I differ from the manufacturer's instructions, which tell you to mount all the fittings and support brackets, then snap the gutter sections in place. I found it easier to install one section at a time. With one fitting and three support brackets mounted to the fascia, I would snap

the next coupling or fitting onto the gutter section before I put it in position, then screw that fitting to the fascia after the gutter length was in place. This avoids a return trip with the ladder or scaffold and also insures that measurements between fittings are precise. This is important, since an expansion line is present in the fittings that lets each length move individually. Miscalculation could cause buckling or leaking problems.

Raingo recommends that a special silicone lubricant be applied to the seal before it is positioned. While GSW didn't specifically recommend this, a coat of silicone helped the material snap together more easily.

Cutting gutter lengths is no problem at all. Any fine-tooth saw such as a hacksaw or coping saw works well. But I recommend use of a miter box for good square cuts. Smooth off any burrs with a file or knife before inserting cut edges into fittings.

While your choice between the two systems may be determined by availability in your area, there are some differences. Most apparent is color. Raingo is slightly off-white, while the GSW is snow-white. Matching your house trim may be a consideration, especially if you choose to use no other finish.

To make a fair comparison of ease of assembly, I installed the systems on days that were approximately the same temperature. The Raingo seemed to have a definite edge—the parts fit together more easily and pre-

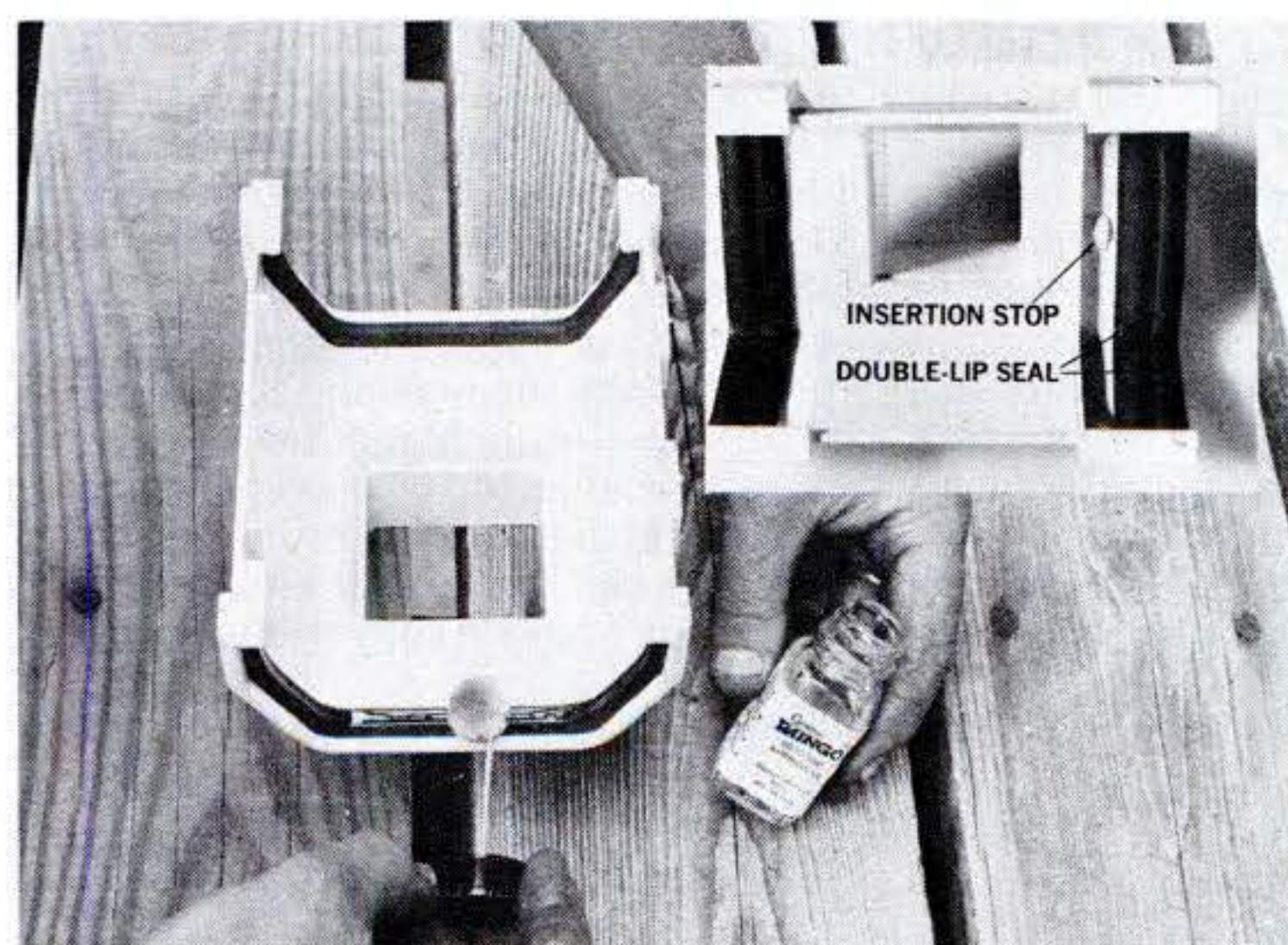
cisely. The GSW had a double-lip seal at each fitting; this may have accounted for the somewhat stiffer assembly, but may also be double insurance against future leaks.

Raingo has ridges that run the length of the gutter to help strengthen the material, and that also allow water to run beneath leaves, debris, and ice to flush them away. They seem to work: While it was necessary to clean leaves from both systems during periods of heaviest leaf fall last autumn, the Raingo tended to clear itself more readily of normal accumulations. Other than these minor differences, there were no problems with assembly or operation of either system.

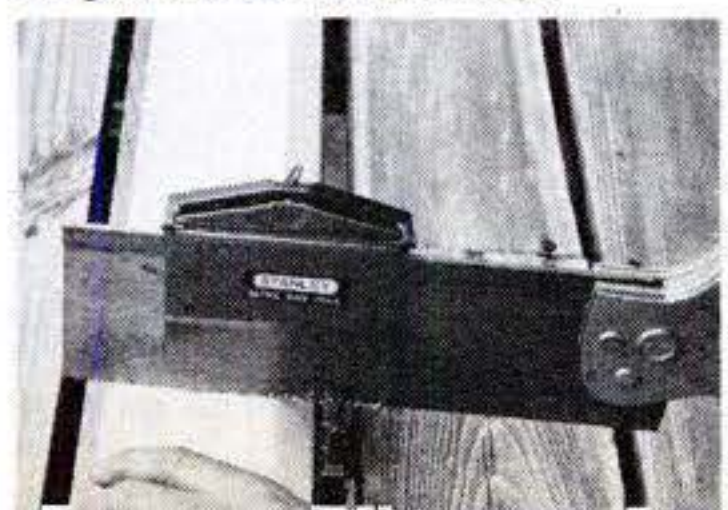
What of the complaints you hear about vinyl gutters? These systems are well-supported and should present no problems with sagging or drooping. Leaning a ladder against them to climb on the roof may bend them inward, but they will reshape themselves as soon as the weight is removed. I've had no problems with leaks. Under certain conditions, direct sunlight can cause enough expansion to create a popping sound, but that's a small price to pay for a no-maintenance system that will do its job for years. [23]

WHO MAKES VINYL GUTTER SYSTEMS

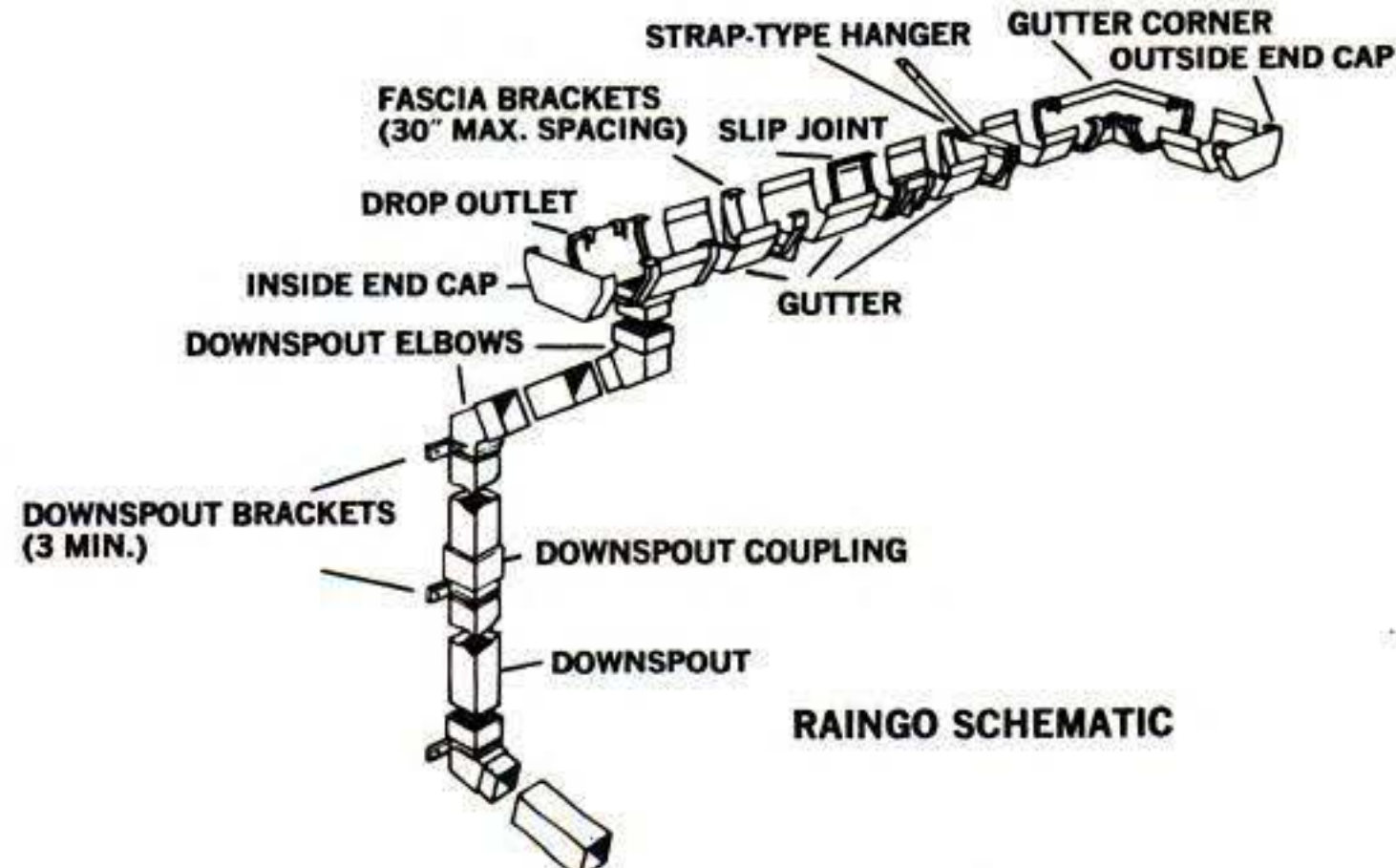
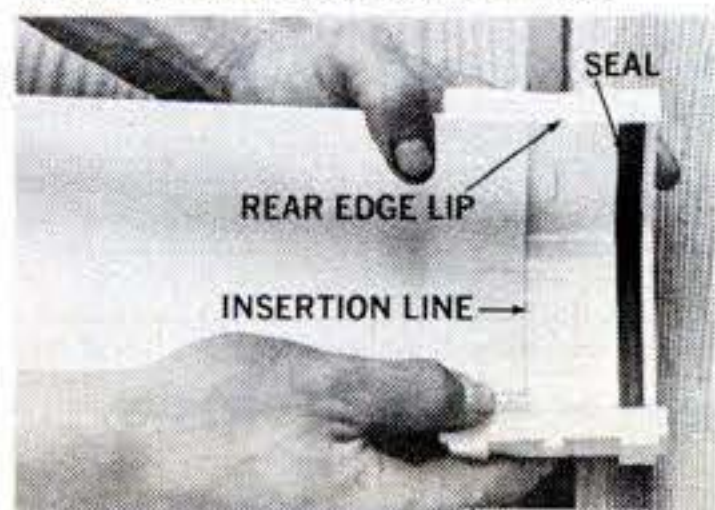
Plastro, 920 D Shelley St., Springfield OR 97477; **Raingo**, Genova Bldg. Products Div., 7034 E. Court St., Davison MI 48423; **Snap-Seal**, GSW Ltd., Box 526, Stn. B, Hamilton, Ont., Canada L8L 7X6. (Nearly identical but not tested by either author is a system sold by **Gazelle Inc.**, Box 701, Tomah WI 54660.)



Miter box keeps cuts square for firm contact with sealing surface of fitting. Use fine-toothed saw, then smooth cut edge before assembly.



To snap gutter section into fitting, insert rear edge under lip, push front down until it snaps in place. Insert only to insertion line indicated below.



Dozen components handle all situations. Though part names vary, Snap-Seal system is similar. Seals (left) differ, though: Raingo has single, Snap-Seal a double lip (inset).

Author drove mounting screw in Raingo fitting after each gutter length was in place. With Snap-Seal, gutter is placed after you mount fitting.



Mount brackets 24\"/>



Announcing Popular Science's second **FRP PROJECT CONTEST**

You can win
\$2000
in cash!

Five \$750
awards,
plus \$1250
additional
for the
Grand Prize
winner—and
there are five
more prizes

To demonstrate the vast range of applications for FRP panels, we've chosen the sampling on the next page from last year's entries. Along with Tom Kloss' Hawaiian dome, shown in color on this section's cover, these projects just missed winning, for various reasons. For example, the dome, the potting shed, and the pontoon boat were passed because FRP wasn't the dominant material in their construction, though all three used it cleverly: Triangular panels of it skin much of the dome's 26-ft.-diameter, $\frac{3}{4}$ -sphere tubular frame; the shed's bay window provides a light-bathed potting bench while doubling as passive collector and drying rack. The boat (shown in winter dry dock, here) uses colorful Filon Stripes for both railing and awning. The other projects were judged too special for broad appeal, though both are practical uses of FRP.

● **PRIZES:** There will be five cash awards for a total of \$5000, to be distributed as follows: a check for \$750 to the winning entrant in each of five project categories plus an additional check for \$1250 to the entry designated as Grand Prize winner, to be selected from the five category winners. There will also be five Honorable Mention awards (one per category), the winners to receive a selection of how-to books from the *Popular Science* Book Division.

● **HOW TO QUALIFY:** Projects in any of the five categories must employ translucent FRP panels as the dominant material. While there's no limitation on how little or how much FRP and other material is used in the construction, be sure that (a) you choose the proper type of panel (see our "Buyer's Guide," next page, listing types of FRP panels and the projects to which each is suited), and (b) that your project can be built with home-workshop tools.

The five contest categories are: Solar Glazing (any project, active or passive, that uses FRP to capture or conserve energy); Greenhouses; Covers (such as patio roofs, carports, awnings, firewood canopies, boat shelters); Fences and Screens (including partitions, room dividers); and Miscellaneous Structures (any other logical use of FRP, such as storage sheds, cabanas, garden lamps, compost bins).

Projects should be skillfully designed for efficient use of standard-size FRP panels (with a minimum of waste) and related materials such as wood or metal framing and accessories. We're seeking functional, structurally sound design as well as decorative and ingenious projects.

● **HOW TO ENTER:** Fill out our entry coupon or list all information the coupon calls for on a separate sheet of paper. Mail this with at least one clear photograph (black-and-white or color print preferred but color transparency is acceptable) plus a dia-

gram of the construction details. A crude pencil sketch will suffice if it is thoroughly and accurately labeled with essential dimensions. Please do not submit scale models, or plans sheets larger than 18 by 24 inches. You must also provide a list of all materials used: grade or type of FRP panels plus any lumber, hardware and finishing materials (paint, stain, etc.). Also, include any special construction tips you'd like to pass on to anyone attempting to duplicate your project. If the photo you submit is deemed unsuitable for publication, *Popular Science* and Filon reserve the right to arrange photography at your convenience.

Entries must be delivered to the Hawthorne address by Sept. 30, and become the property of Filon and *Popular Science*. Print the category you're entering (Greenhouse, Covers, etc.) in the lower left corner of your envelope. (Only one entry per envelope, please.) No entries can be acknowledged and none will be returned unless accompanied by a written request and a self-addressed stamped envelope with sufficient postage (no checks or money orders).

● **JUDGING** (by PS Reader Activities Editor Al Lees and representatives of Filon) will be for the most efficient and appropriate use of the translucent FRP panels you choose. Prize winners will be notified by Nov. 3. PS will publish dimensioned sketches of those prize-winning projects we feel our readers might wish to duplicate. All 10 winning projects will be shown in the March 1981 issue of *Popular Science*, and plans for them will be available from Filon at that time.

● **PLANS** for duplicating the 10 winning projects from the previous contest—they were shown in our March 1980 issue—are now available (at 50¢ each) from the address in the coupon. Your Filon dealer has an order form describing the plans, if you don't have a copy of that issue.

— — — — — ENTRY COUPON (Clip and attach to your plans sketch) — — — — —

Mail entry to
POPULAR SCIENCE FRP CONTEST
Filon Div., Vistron Corp.
12333 So. Van Ness Ave.
Hawthorne, Calif. 90250

To qualify, entry must reach Hawthorne address by Sept. 30, 1980

YOUR NAME (print or type) _____

ADDRESS _____ Daytime Phone No. _____

CITY _____ STATE _____ ZIP _____

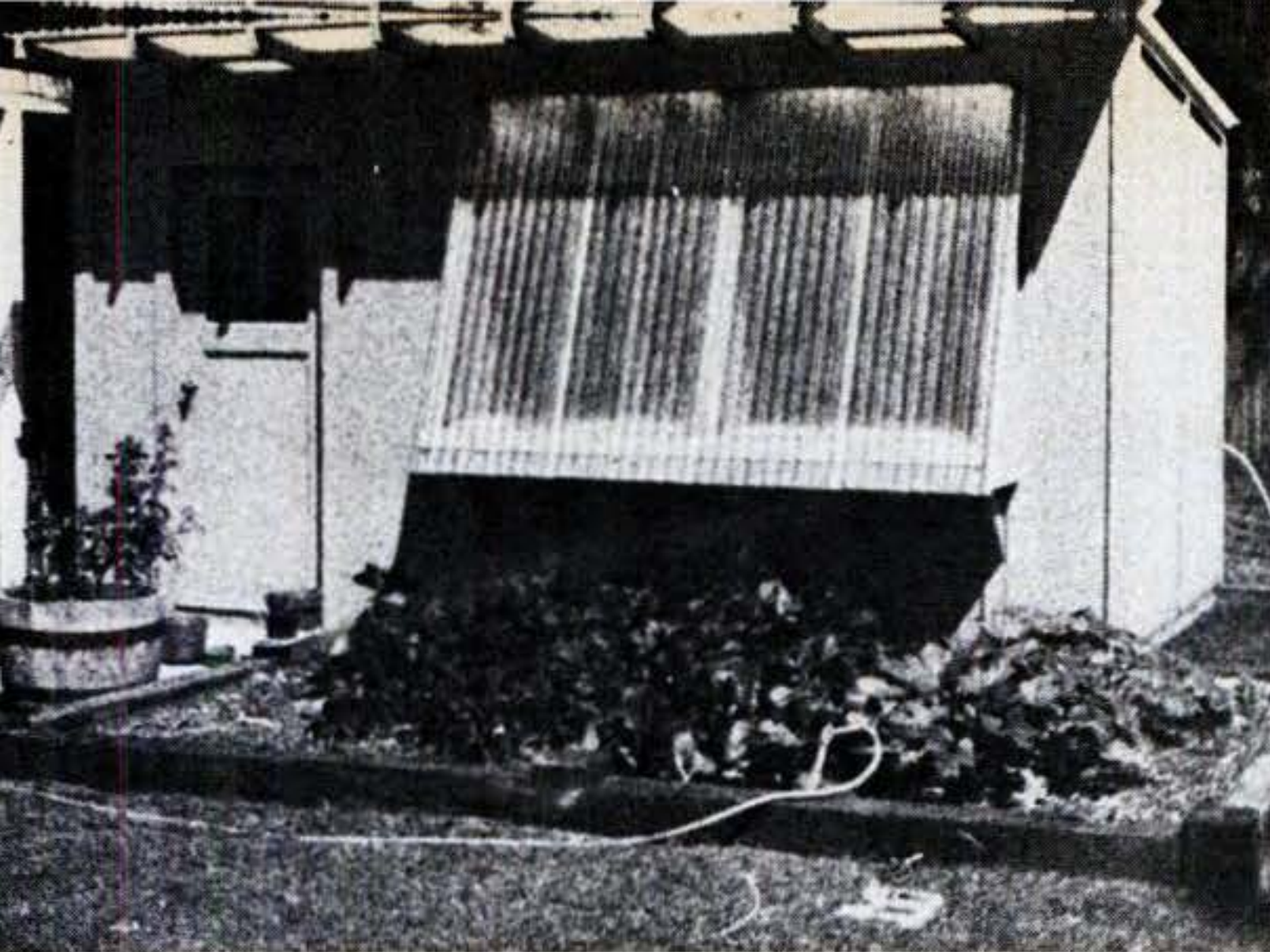
Which category are you entering?
(Check one and write it on your mailing envelope)

☐ Solar Glazing ☐ Greenhouses
☐ Covers ☐ Fences and Screens
☐ Misc. Structures

What type, weight, and profile FRP panels did you use? _____

How many? _____

Sign here _____
(My signature certifies that this project is of my own design.)



POTTING SHED

ART FRUHLING, Yuba City, Calif.



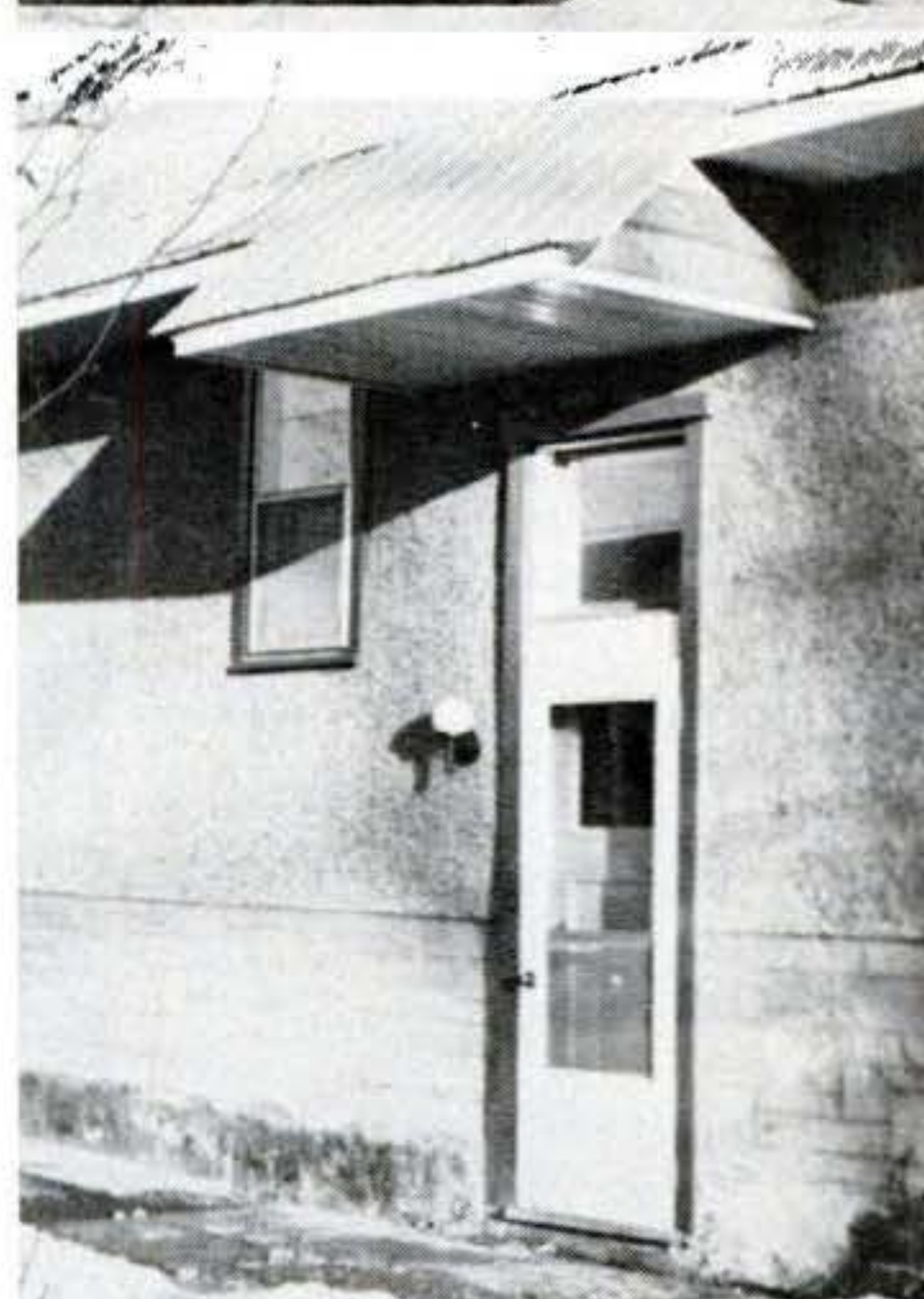
PONTOON BOAT

ORVILLE DUBIE, Toccoa, Ga.

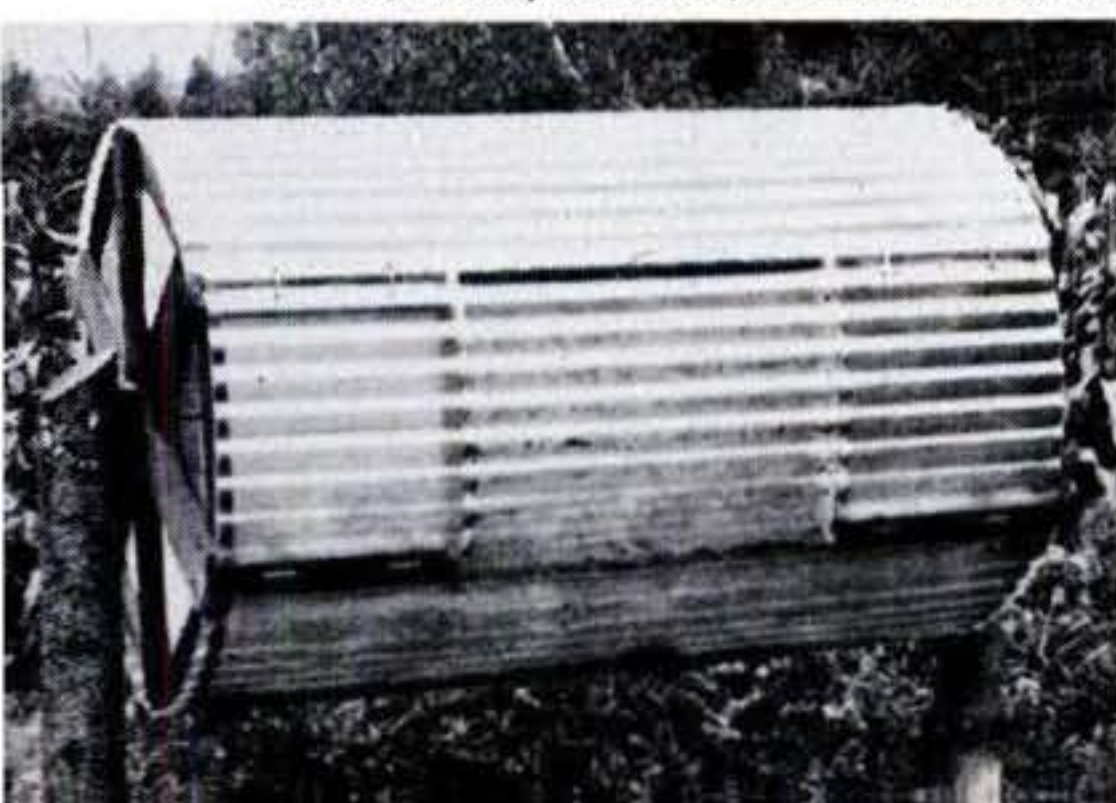
PS BUYER'S GUIDE TO FRP PANELS

Categories	Recommended FRP	Wt. per sq. ft.	Standard sizes
Solar glazing	Any gel-coated or Tedlar-coated clear FRP panels (such as Filon Supreme)	4 oz. and 5 oz.	Profile: 2½" x 9/16" corrugated Widths: 26", 51½" or 52¼" Lengths: 8', 10', 12ab3w Profile: Flat Widths: 36" or 48" Length: 50' rolls
Greenhouses	Any clear FRP panels with a light-stabilized resin (such as Solar-Gro)	4 oz. and 5 oz.	Profile: 2½" x 9/16" corrugated Width: 26" Lengths: 8', 10', 12' Profile: Flat Widths: 36" or 48" Length: 50' rolls
Covers (patio roofs, carports, boat shelters, etc.)	Any corrugated or architectural ribbed FRP panel	4 oz. and 5 oz.	Profile: 2½" x 9/16" corrugated Width: 26" Lengths: 8', 10', 12'
Fences and screens (outdoor fences, room dividers, screens, etc.)	Filon-Stripes	5 oz.	Profile: 4" x ¾" ribbed Width: 26" Lengths: 8', 10', 12'
Miscellaneous structures	Cool-Rib	4 oz. and 5 oz.	Profile: 2½" x 9/16" corrugated Width: 26" Lengths: 8', 10', 12'
	Sunbreak	5 oz.	Profile: 2½" x 9/16" corrugated Width: 26" Lengths: 6', 8', 12'

Note: Solar-Gro, Sunbreak, Filon-Stripes, and Cool-Rib are trademarks of Filon Div. of Vistron Corporation. Other manufacturers of FRP panels include: Alsynite/Structoglas Div. of Reichold Chemicals Inc.; Barclite, Barclay Industries; Glasteel; Kalwall Corp.; Lasco Industries; Ornyte.



Entry air lock cut heat loss during long Canadian winter. Spring-loaded panels of FRP snap under existing door canopy, above; in summer they demount for storage. From E. J. Smith of British Columbia.



Tumbling compost bin, built by George Coyle of Cromwell, Conn., used three rough-finish, corrugated 12-ft. panels nailed to wheel-like ends. Hinged lids drop for filling and dumping into barrow.

Tough entry hardware

to guard your home

New locks, guard plates, and strike reinforcers can foil burglars

By **PAUL BOLON**
PHOTOS BY JOHN KEATING

Most homes are like Cracker Jack boxes: They're easy to open and have prizes inside. That's how burglars contemptuously describe houses with key-in-knob-type locks. Unfortunately, the majority of American homes rely on this lock along with inadequately secured windows and sliding glass doors. So it's not surprising that the burglary rate in the U.S. is skyrocketing.

Your home, however, doesn't have to be an open invitation to looters. With today's new generation of stronger locks and install-it-yourself security hardware, you can defeat all but the most persistent burglars.

Improved entry security can be achieved with new pick-resistant lock cylinders, cylinder guard plates, and strong new deadbolt locks. To find out what types are best, I interviewed police anti-burglary experts and leading locksmiths. I also collected and checked out dozens of new cylinders, locks, and security hardware items. Here's what I found out about entry-door security. (We'll follow up in our July issue with security advice for windows and sliding glass doors.)

Two deadbolts

"We recommend that people use two strong deadbolts on their doors," says Guy Capolupo of the New York City Crime Prevention Squad, and a locksmith himself. "On wood doors, the heavy-duty, one-inch deadbolts made of steel should be used. These can stop burglars from getting through, while the older standard bolts—whether in mortise locks or as added auxiliary

locks—we found very easy to overcome with physical force," Capolupo says. "We could rip them out in less than a minute."

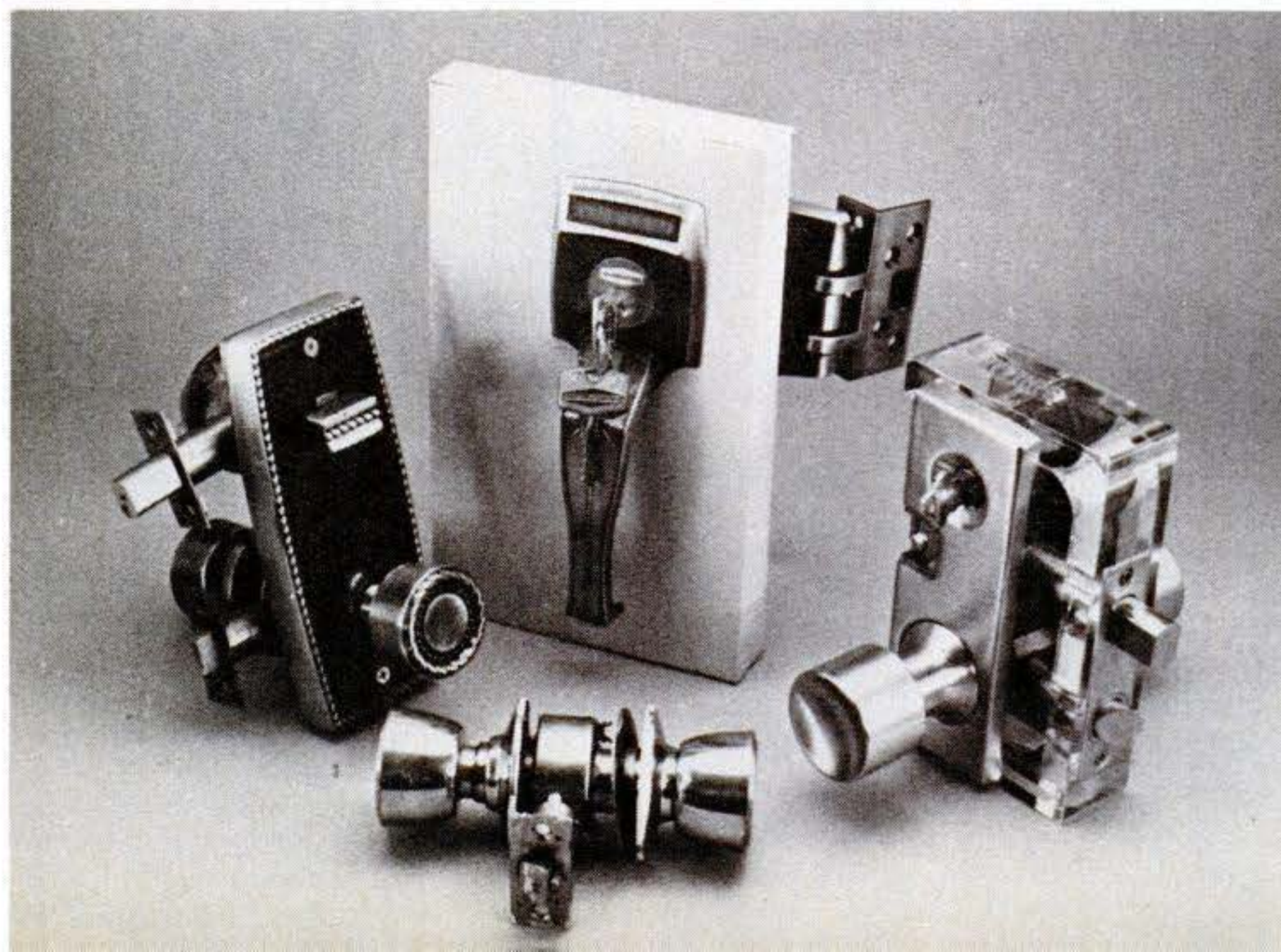
A deadbolt may be part of a knob lockset, or a separate auxiliary lock above the knob. The body of these locks is in the door itself. Their bolts should be made of hardened steel; some have free-spinning, hacksaw-resistant rods inside.

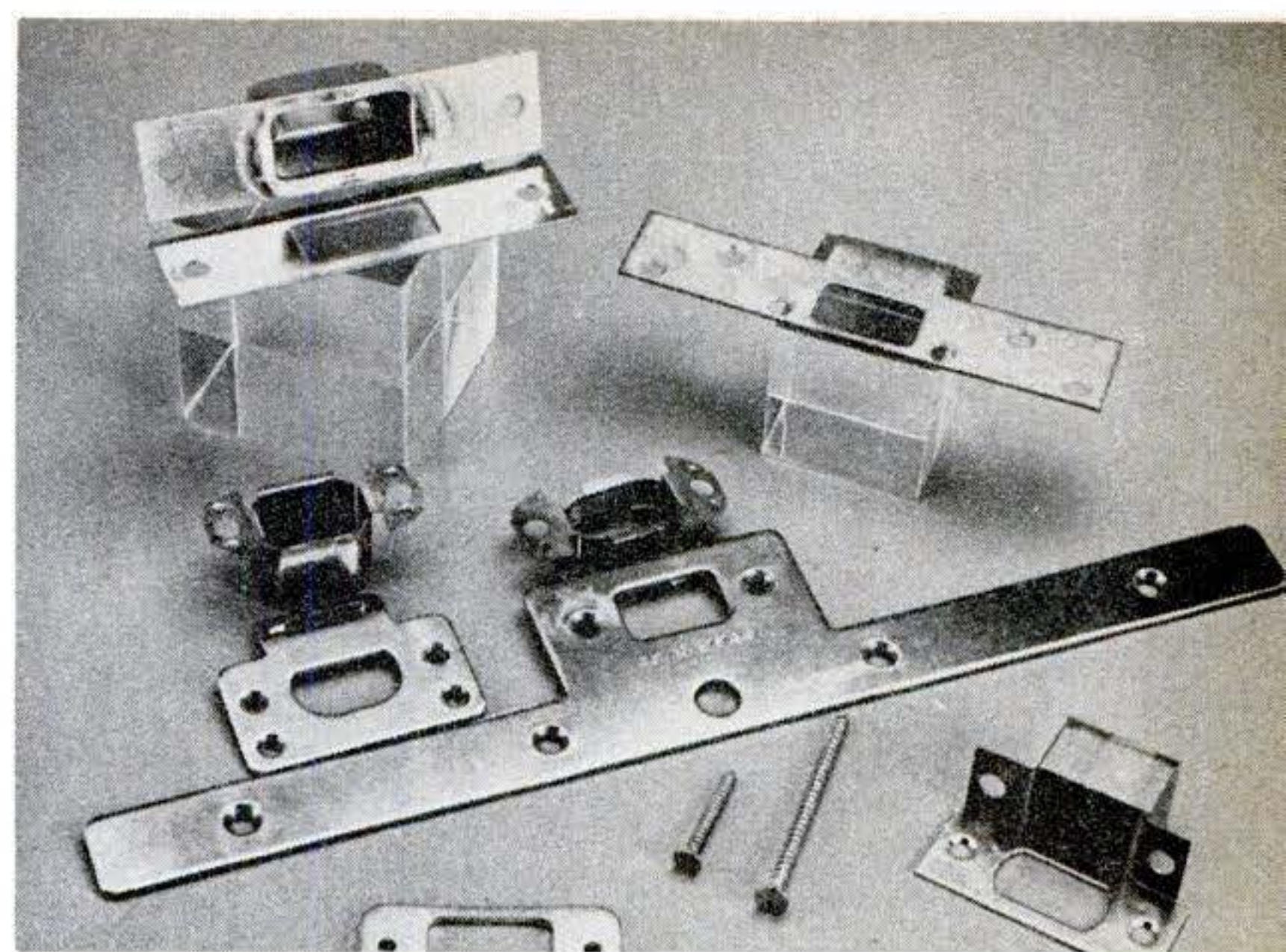
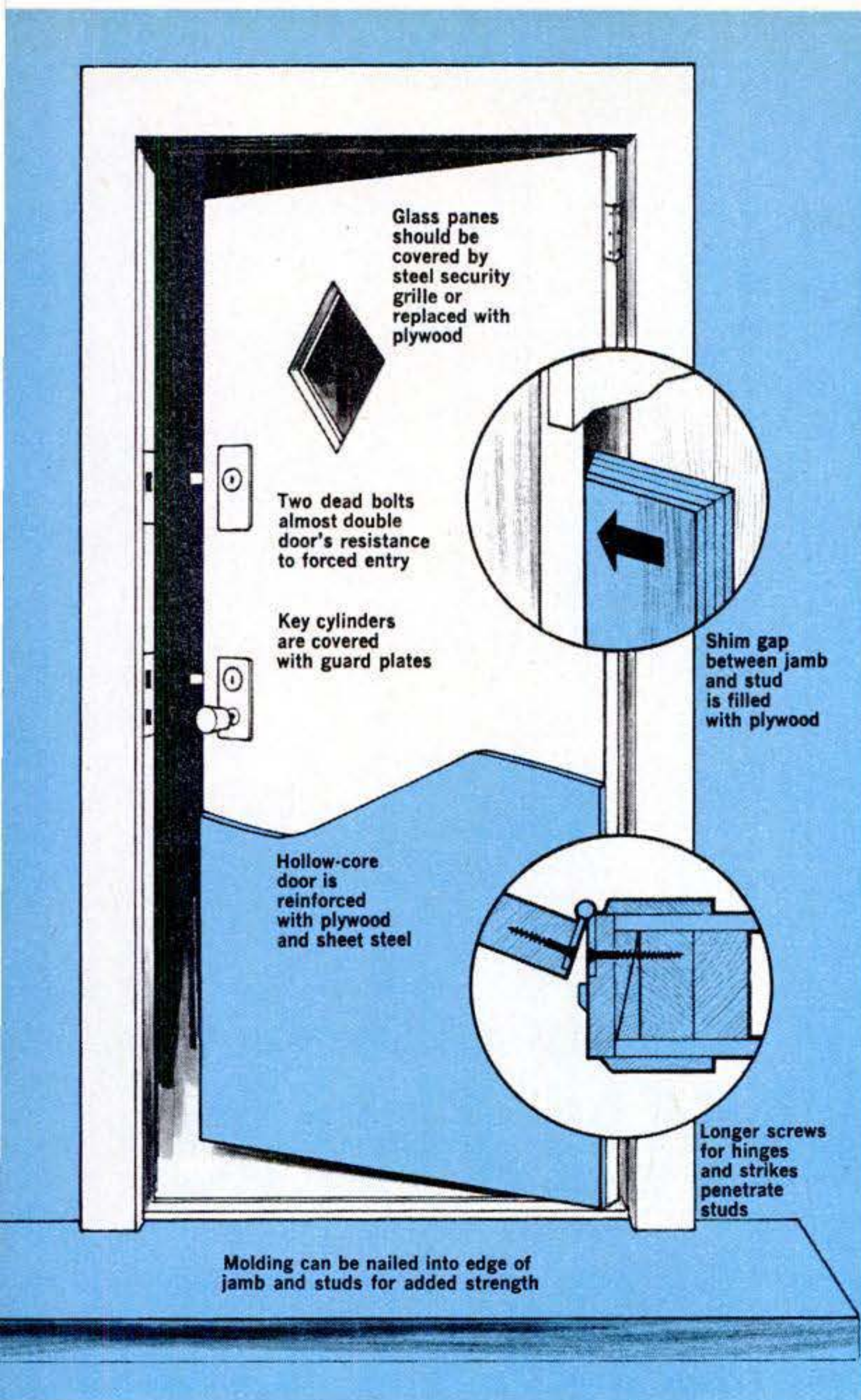
Vertical deadbolt locks, or drop bolts, are auxiliary rim locks. The lock body mounts on the inside of the door. Its bolts align and interlock with the metal hoops of a heavy strike on the jamb. The drop bolt is especially resistant to prying attacks.

One lock that adds a deadbolt without requiring any additional drilling on the door is the Super Guard II made by Ideal (about \$25). It's also sold by Sears, J.C. Penney, Montgomery Ward, and others. This lock has a fixed outside handle and a drop-bolt rim lock inside (see photo). It's a direct replacement for the key-in-knob. I was able to replace a knob with this lock in about five minutes; it assembles with four through bolts so there's no special preparation of the door. It took another 15–20 minutes to chisel out and mount the angled strike.

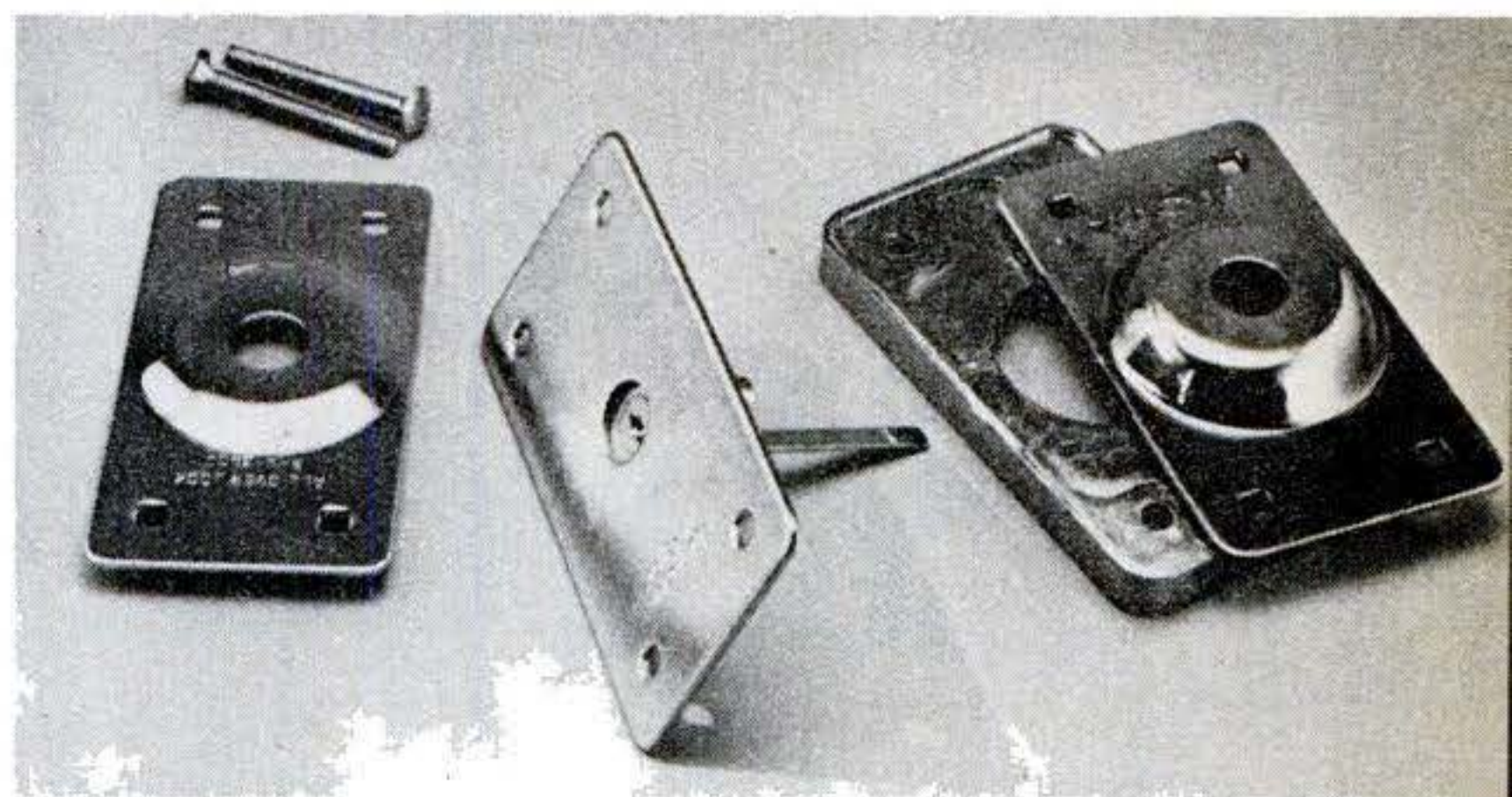
The Super Guard II has two modes of operation determined by a sliding button on the back. In the usual mode, whenever the door is shut, a latch on the lock body will hit the strike and throw the bolt. In the second, "lock

Typical key-in-knob lock (center foreground) can be replaced by interconnecting locksets such as National's (left) or Schlage G (right), which add a deadbolt but require drilling more holes in door. Ideal's Super Guard II (rear) fits original knob hole. It has a fixed handle outside, with a rim-mounted drop bolt inside.





Reinforced strikes help to spread force applied to the door over greater area of door jamb. Strikes should have a minimum of four 2½-to-three-inch fully threaded screws to tie it into studing. Some strikes have metal box that is mortised into jamb.



Single most important security upgrade for your door is to protect key cylinder from assault. A variety of strong plates—from flat to large bubble, as well as a mount (under plate at right)—lets you cover protruding collars. Kits cost \$2.50–\$10.

out,” mode, the bolt will either be engaged or withdrawn until the button is moved; you can’t even open it with the key. This presents some risk in a panic fire situation.

The Super Guard can keep the door shut without locking because there is a spring-loaded ball that replaces the latch on the edge of the door. When the door is shut, the ball fits in a shallow depression on the strike. It’s not as reliable, however, as a positive latch: The door would probably blow open in a strong, direct breeze.

Auxiliary locks

Another way to add a deadbolt to your door is to install an auxiliary lock above the knob, or replace your knob with an interconnecting lockset, which combines a knob-and-latch and a deadbolt. Installation of either is similar [PS, Oct. '78]. It only requires drilling three new holes: one in the face of the door, another into the door’s edge that meets the first, and a third in the jamb. After the holes are drilled, the cylinder is

aligned with a plate on the back of the door, screws installed between them, and the strike mounted on the jamb—about a 45–60-minute job.

An interconnecting lockset requires exact placement of the deadbolt hole above the knob hole. These locksets range from \$35 to over \$100. Most are in the \$40–\$55 category. Compared to auxiliary locks, locksets are an expensive way to add a deadbolt. If you’re buying one, be sure it has the panic-proof feature: A twist of the inside knob retracts both latch and deadbolt. That’s a boon you can’t get with a separate deadbolt.

Many locksmiths prefer the deadbolt made by Lori (\$19) as an auxiliary lock because its own standard (not highly pick-resistant) cylinder can be replaced by any pick-resistant key cylinder, so you can choose your own. Medeco’s deadbolt (\$48) has a two-inch bolt, for extra strength. When the bolt is thrown, a full inch remains within the steel guide inside the door panel. In addition, Medeco comes with its own pick-resistant cylinder.

You can also add a deadbolt to your door without drilling a new hole above the knob. Schlage makes a very large-diameter deadbolt—the 560 model—that is designed to fit in the 2½-in. hole of the typical knob. This lock takes four ¼-in. through bolts—probably the best-secured deadbolt you can buy.

Other deadbolts can be adapted to fit the larger hole of the key-in-knob, too. Unless you leave your entry door unlocked, you don’t really need the knob and latch.

For wood doors, police recommend adding deadbolts instead of drop bolts, but the latter can be safely added if at least two of the four holes on the lock body are used for *bolts* (not screws) that pass back through the door and whose heads are covered with a plate—usually the cylinder guard plate. Nuts would then snug down on the lock body. In addition, mounting a drop bolt requires drilling only a single (usually 1¼ in.) hole through the door for the cylinder, and some chisel

Continued

If your fuel bills make you see red, think pink.

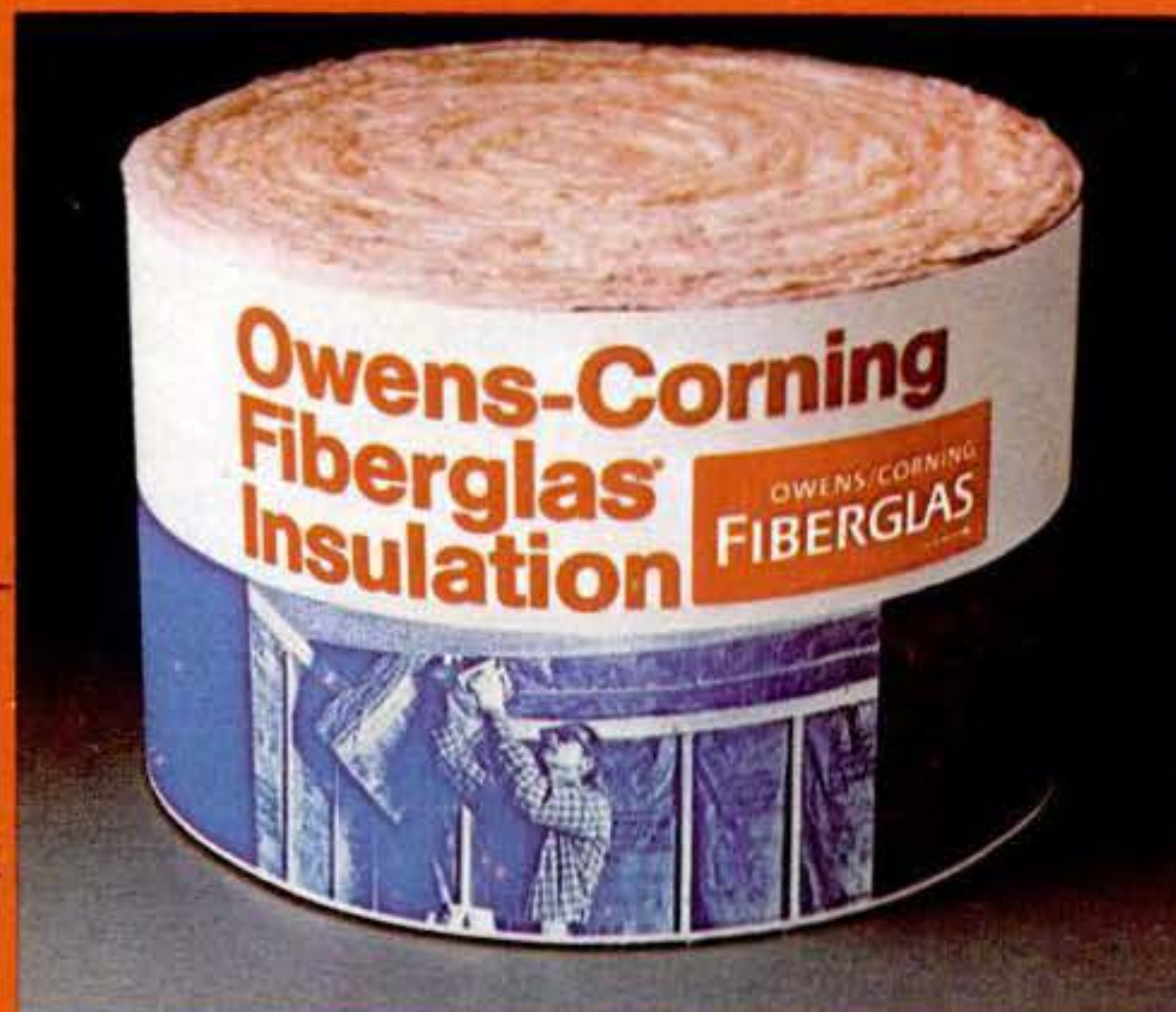
There's one brand of insulation that gives you more than any other.

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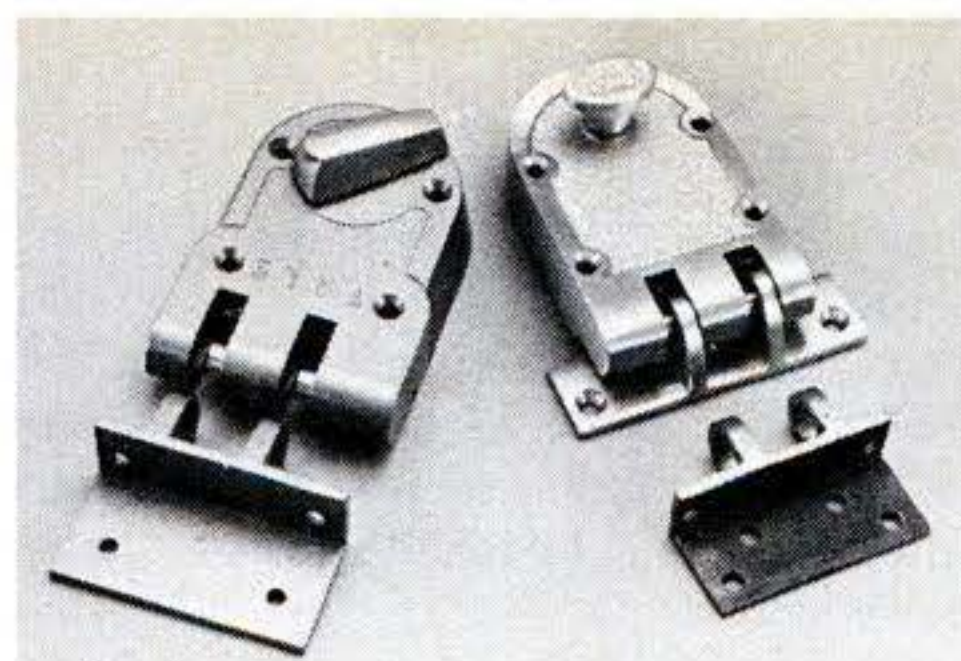
All of which may explain why Owens-Corning Fiberglas is the most widely used brand of insulation in America.

And why, when you think about insulation, you ought to think pink. *TM Reg. O.-C.F. Corp. ©O.-C.F. Corp. 1989

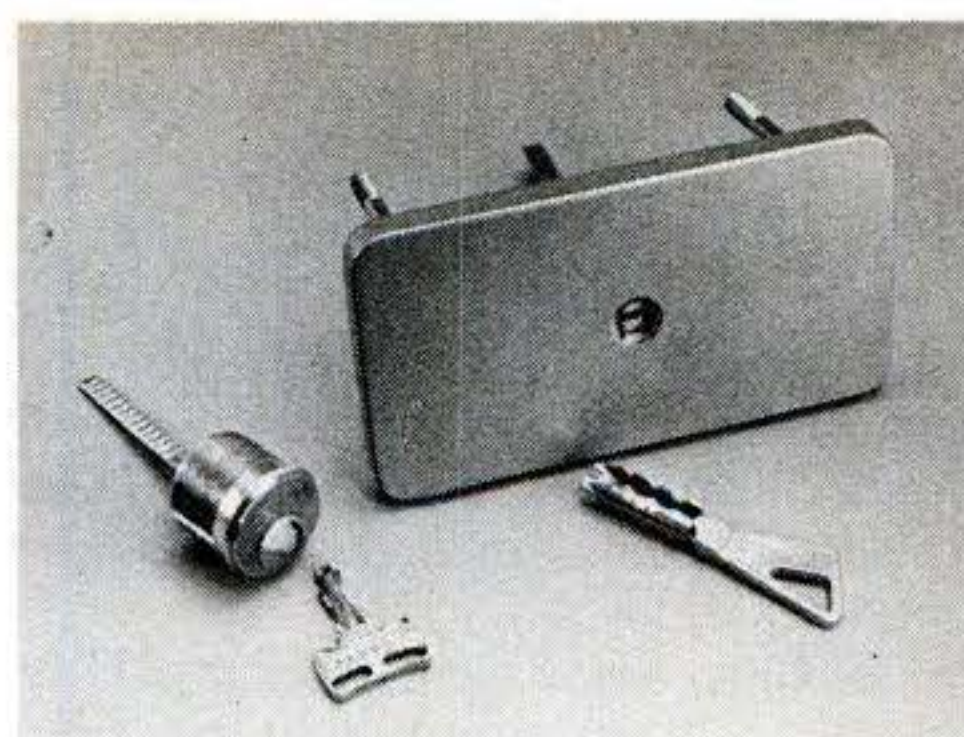
Savings vary. Find out why in the seller's fact sheet on R-values. Higher R-values mean greater insulating power.



Auxiliary deadbolts for wood doors now have heavy collars and stronger strikes. Medeco (left) comes with its own pick-resistant cylinder. Lori (right) is preferred by locksmiths—it accepts any high-security cylinder you choose as replacement.



Drop-bolt locks are rim-mounted. Yale (left) costs \$18 and is very strong; Segal (right) is \$25 and remains the favorite, but its flat strike should be replaced. Most drop bolts have weak collars that can easily be covered with a guard plate.



Best cylinders at present are the Norman (left) and Fichet (right). Fichet should be used in its plate-guarded version; it only replaces cylinders of rim locks. Both locks have unusual keys: Norman's is tight-fitting curve; Fichet's is "I" cross section.

work to mount the strike on the jamb. The positive interlocking drop bolt makes it one of the best ways to increase door strength.

You should expect to pay at least \$15 for a drop bolt; there are less expensive brands but they're usually made with cheaper alloys. Segal made the original drop bolt, and many locksmiths prefer it. All drop-bolt cylinders have a thin collar, so it's easy to mount a guard plate over them. Only Emhart's drop bolt comes with a pick-resistant cylinder, but it's easy to replace any other drop bolt's cylinder with a pick-resistant one. (If you have a metal door with a deadbolt, the second lock on it should be a drop bolt.)

For a wood door with a mortise lock, about the only choice is to add an auxiliary lock since removing the mortise lock leaves a large cavity that can't be properly strengthened. It is important, however, to cover the mortise lock's cylinder with a specially shaped guard plate having holes both for the key and knob. Then add a deadbolt 12–20 inches above it.

Many people mistakenly concentrate their security hardware on their front doors. Burglars usually reverse that emphasis: Back doors are often poorly lit and offer greater protection from detection. Back doors also frequently have large glass panes.

Incidentally, night latches, locks that are operated only by a turn button from inside and mounted on the back of the door, aren't effective deadbolts. The spring-operated or beveled latches are easily opened from the outside, and even the heavier deadbolt models are invariably attached to the door with a few wood screws. Wood or sheet-metal screws can't effectively hold a lock on a wood door when force is applied.

Guarding the cylinder

All key cylinders need guard plates (see photo); without them, even the best cylinders can easily be wrenched out. "The use of a guard plate alone,

on a good door, will reduce a burglar's chances of getting through by 50 percent," says Guy Capolupo.

Guard plates are inexpensive and easy to install—about a half hour's work. Even cylinders on some new deadbolts with heavy, tapered collars are still susceptible to some assaults. That's why it's advisable to put a guard plate over these collars, too, Capolupo says.

High-security cylinders

"Ninety percent of all key cylinders sold can be picked in 10 seconds," a leading lock expert told me. This sounds more alarming than it is, since only 10 percent of illegal entries into homes are unforced—and most of these are with copied keys.

Since standard cylinders can be opened with simple tools, police recommend use of a pick-resistant cylinder on one of a door's deadbolts. One extra benefit of a high-security cylinder is that some insurance companies balk at paying for burglaries without evidence of forcible entry.

A high-security cylinder is not only difficult to pick, but will also resist all kinds of physical assaults, even drilling. Key control is also important. Ideally, only a single source—the manufacturer or factory—will have key blanks and the computer-coded machines for grinding duplicates of complicated keys.

Unfortunately, there are locks that are advertised as pickproof or pick-resistant that never were. There are no standards for pick resistance. It's usually just a question of time until a new "pickproof" model cylinder will be mastered by someone—usually a lock expert. That information—how to pick it—will travel quickly to other locksmiths, but probably not to burglars. But if special tools are developed to beat a particular cylinder, there's not much chance of keeping those in the proper hands for too long.

The best cylinders at present are the Norman (\$32) and the Fichet (\$65

with its recommended guard plate). The Norman cylinder [PS, Jan.] is a recent invention with a principle of design different from that of pin-tumbler locks. Its maker says that it can't be picked, and so far it hasn't been. The Norman has positive key control—keys available only from the factory. It can adapt to any lock whose cylinder can be replaced.

The Fichet cylinder was developed in France more than 20 years ago and has still not been picked. But it's too long to be used as a replacement cylinder in deadbolt or mortise locks.

Medeco, MIWA, Emhart, and Sargent-Keso cylinders have been picked or circumvented in other ways by locksmiths, but are still highly pick-resistant and offer significantly more protection against picking than standard cylinders.

The cylinders of almost all rim-mounted locks and most mortise locks can be replaced with high-security cylinders. The key cylinder is separate from the latching mechanism and bolt, and it can be unscrewed easily from the rear on rim locks and most deadbolts. On mortise locks and a few deadbolts, the entire cylinder is threaded. It's screwed into the lock body and secured with set screws from the side or top. It's not necessary to buy an entire lock to get a better cylinder. Police emphasize that since 90 percent of burglaries are forcible, good deadbolts, guard plates, strikes, and strong entry points should take first priority.

If you live in a noisy or commercial neighborhood, police recommend that you consider an alarm system [PS, March '79] as part of your security system.

Entry-point strength

Stronger locks and security hardware have served to underscore the overall weakness of the doors and frames themselves. Many doors and softwood frames are far weaker than

Continued

[Continued]

the locks on them. American houses were not designed or constructed for high security against burglary. In most of the two million reported residential burglaries last year, entry was achieved in seconds, with modest amounts of force.

"It's been our experience," says Guy Capolupo, "that very rarely in a forcible entry does a lock break. When a good lock is properly installed, it usually proves stronger than the door, strike, or jamb. So a good lock is not able to do its job if the entry point itself is not structurally sound or the lock is not well secured to the door."

You can do a lot to increase your home's security, starting with the door itself. A door of sufficient strength to withstand break-ins is a 1¾-in.-thick, solid-core, hardwood door, or a metal door. Paneled, hollow-core, and thinner softwood doors may be pretty, but they can't survive a prolonged attack. Flush or hollow-core doors may be reinforced by covering them with ½- or ¾-in. plywood, and screwing the plywood to the door. Additional protection can be added by covering doors with sheet steel or aluminum. Although replacement metal doors and frames are expensive, they are better fitted and far stronger than wood doors.

Door frames are usually ¾-in. pine or other softwood. To fit a prehung exterior door frame in the wall studding, carpenters usually drive several sets of opposed wedges or shingle scraps to square the surface of the jamb, then nail through the jamb and wedges into the studding with 8d finish nails. It's a great way to true up jambs, but it may leave as much as an inch of shim space between the jamb and studding, leaving the jamb flexible and weak.

Check the space between your jamb and studding by removing the door molding and cutting back the wall board or plaster next to the jamb. (It won't show when you replace the molding.) If there is a gap of ¼ inch or more, the gap behind the hinges, strikes, and on the hinge side opposite the strikes should be filled with plywood to take any flex out of the door-jamb-stud combination. Then the original screws of the hinges and strikes should be replaced with fully threaded, flathead sheet-metal-type screws 2½ to three inches long that will penetrate well into the studs.

More weak spots

Strikes receive and secure the dead-bolt in the door jamb. They are often just small pieces of metal held by short screws that could fail before the

lock body or bolt gives way. Even some of the new deadbolts come with one of these weaker strikes. But most locksmiths stock longer and heavier replacements (see photo) that spread the pressure over a larger area of the jamb.

Glass panes in any door are a high risk. Burglars can break a small pane of glass without too much noise, then reach inside to unlock the bolt. Wood door panels offer the same opportunity to the burglar—many are easily kicked in. Some people answer that threat to a door by installing a double cylinder lock—one that takes a key to lock or unlock from either side of the door.

Adding a double cylinder lock, however, reduces your chances of making a safe exit in case of fire. Guy Capolupo's conclusion, shared by most fire departments, is: "Double cylinders are inadvisable. We know why people use them, but we feel the risk factor in a fire outweighs any advantage in security. In a panic situation, fumbling for a loose key can prove fatal." And if a burglar entered your home through a window, for instance, he would have little trouble getting past a double-cylinder lock to exit.

There are many safer things you can do to protect a vulnerable door, such as covering small panes with steel security grills, or replacing glass with heavy plywood.

"The burglar is basically an opportunist, and you want to limit his opportunity," says Capolupo. "What you're really doing is developing a time barrier. The enemies of the criminal are time, noise, and light. The more of these you can put in his way with your security system, the better off you are. The longer it takes him to gain entrance, the greater are the chances he will either not try, or be caught in the act." E5

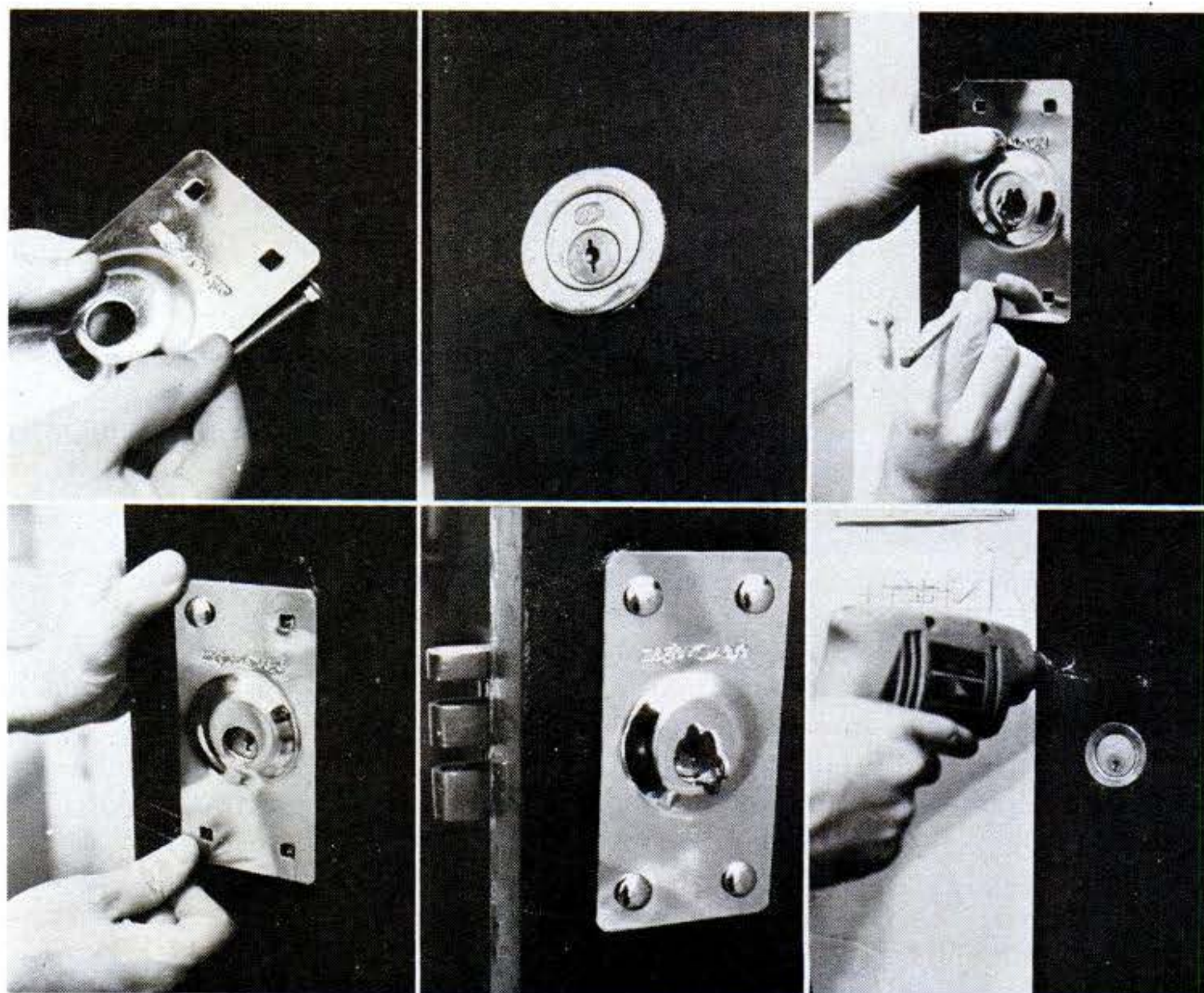
MANUFACTURERS' ADDRESSES

If products are not available from local locksmiths, or for more information, contact the companies below.

Cylinder guard plates: **AFCO Security Products**, 148 Ferris, White Plains NY 10603; **Magic Eye**, 100 Oak St., Norwood NJ 07648.

Key cylinders: **Emhart Industries**, 225 Episcopal Rd., Berlin CT 06037; **Fichet Inc.**, Box 92, Halesite NY 11743; **Medeco Security**, Box 1075, Salem VA 24153; **MIWA Security Control**, 220 Third Ave. So., Seattle WA 98104; **Norman—Pragmatic Mfg. Corp.**, Rt. 301, Carmel NY 10512; **Sargent-Keso**—Sargent Div. of Walter Kidde and Co., 9 Brighton Rd., Clifton NJ 07015.

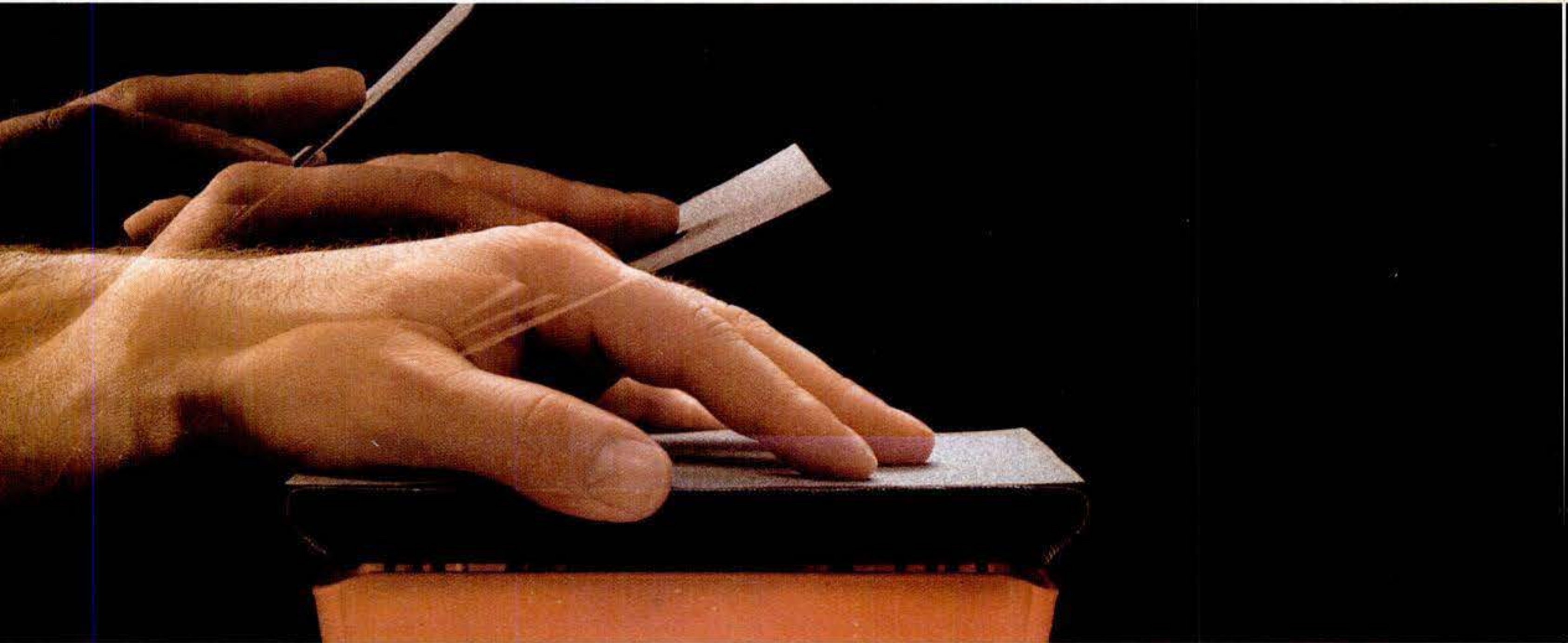
Locks: **Ideal Security Hardware**, 215 E. 9th, St. Paul MN 55101; **ILCO**—Unican Security Systems, Box 2543, Rocky Mount NC 27801; **Kwikset Locksets**, 516 E. Santa Ana St., Anaheim CA 92803; **Lori Corp.**, 6 Old Turnpike Rd., Southington CT 06489; **National—Econo Trading**, 1901 9th St., Rockford IL 61101; **Yale Security Products**, Box 25288, Charlotte NC 28212; **Schlage Lock Co.**, Box 3324, San Francisco CA 94119; **Sears**—Sears Tower, Chicago IL 60684; **Segal**—New England Lock, Box 544, South Norwalk CT 06853.



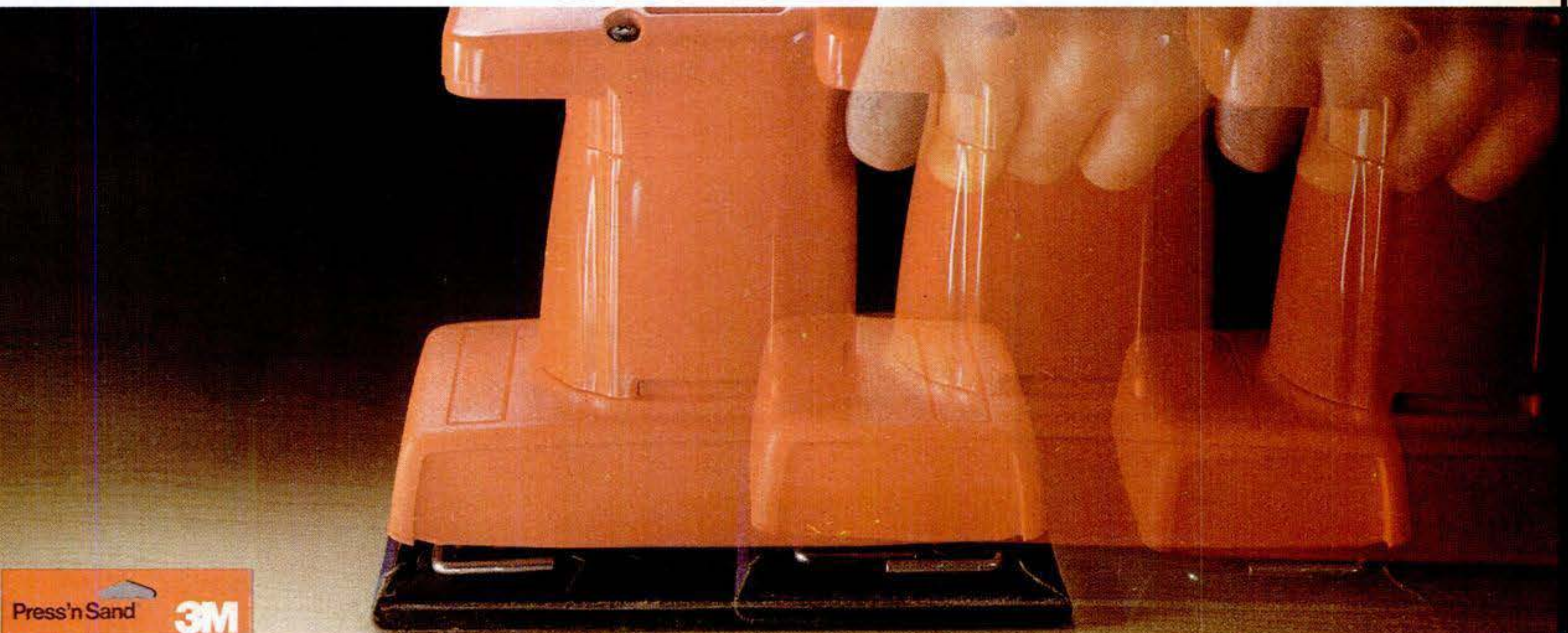
Cylinder-guard-plate installation requires only a drill and one wrench. Kits come with carriage bolts, washers, nuts, and sometimes decorative cover nuts to hide bolt ends. Square shank of carriage bolts will snug into square holes in the plate when tightened. Typical cylinder (upper center) has only a weak collar surrounding it. To install the guard plate, cen-

ter the plate's hole over the key hole (upper right). Before marking bolt holes, make certain that the key rotates completely without hitting the plate. First bolt hole can then be marked and drilled. Mount plate with the first bolt, check that key still rotates freely, then drill remaining holes and tighten. Plates are available in brass finishes. (Photos by the author.)

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DIY add-on screen porch

with a rustic flavor



Heavy, rough-sawn crossbeam and oxbow fixture add appeal to interior.

Attractive post-and-beam construction eliminates screen frames, ceiling joists

By EMERY J. LOISELLE

Open decks [of the types shown earlier in this issue] just aren't appropriate to my rainy, bug-plagued climate. My family yearned for outdoor living, too, but we needed a shelter overhead and full screening. Would it be feasible to add a room-size porch to our home?

A little-used side yard caught prevailing breezes and the afternoon sun, and it abutted a flat gable end of the house. A dining-room picture window

in the wall was in a good spot for conversion into French doors that would provide access to a porch. And a door in the back wall of that porch, away from the street, could lead down steps to the backyard.

I decided that the porch would be a respectable 12 feet wide and 15 feet long, since it would be an entertainment area, a rainy-day play area for children, and a place for hobby activities. Obviously, the simpler the design, the cheaper and faster construction would be. The rustic look of wall beams and exposed rafters seemed to be not only attractive and harmonious with the house's interior, but would also require no finish work.

After drawing plans and obtaining a building permit, we toured the nearby countryside to hunt up a one-man sawmill that could provide us with boards and lumber of native pine. The stock we bought was rough sawn (not planed), and the cost was unbelievably low compared to lumberyard prices. Asphalt shingles, fiberglass screening, and fir decking were purchased later, and these items proved to be the costliest part of the project.

For piers, 18-in.-diameter holes were dug well below the frost line. The holes were filled to grade with concrete and rock rubble, and each pier was neatly capped off with a box form. Metal straps were embedded in the top of the concrete to anchor the posts.

Posts were cut from 4×4 stock. The lower end was dipped in wood preservative, secured to the metal straps on a pier, and braced. Each post's cut-off height was marked with a string level, with the mark on the center posts lowered to allow for a 4×6 beam (see drawing). After cutting, the posts were well-soaked with preservative.

Continued

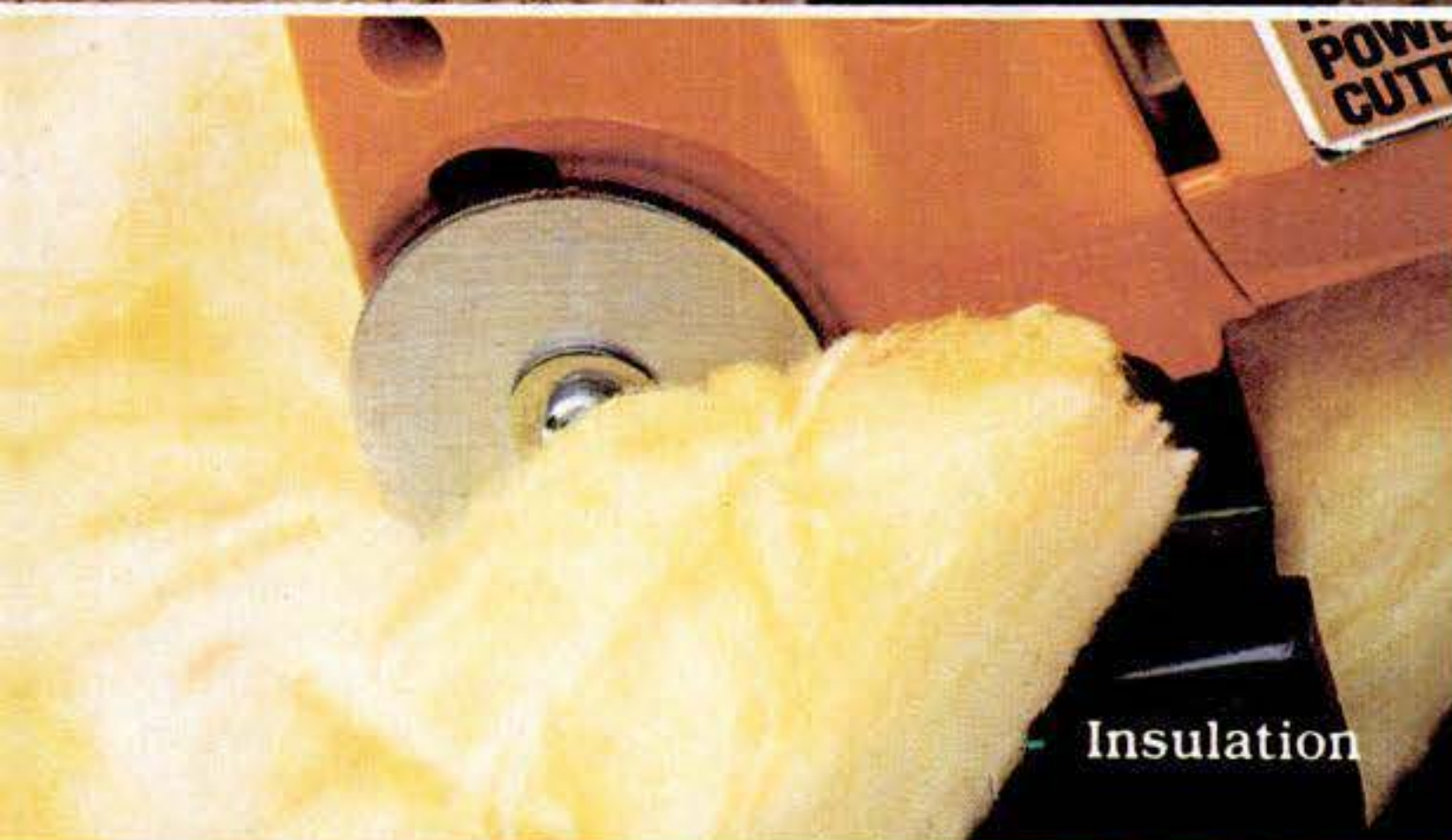




Carpet



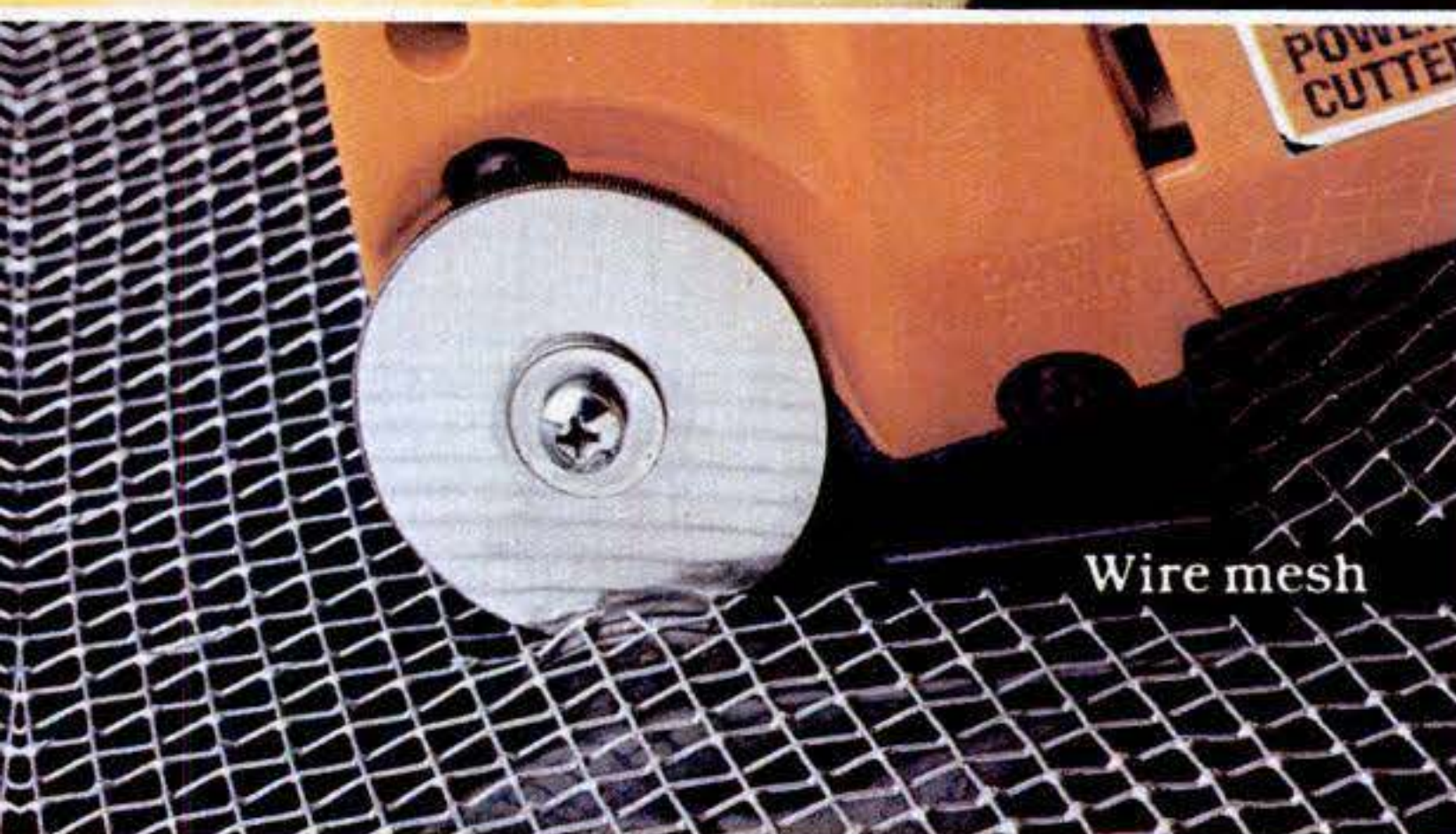
Sheet metal



Insulation



Linoleum



Wire mesh



Canvas

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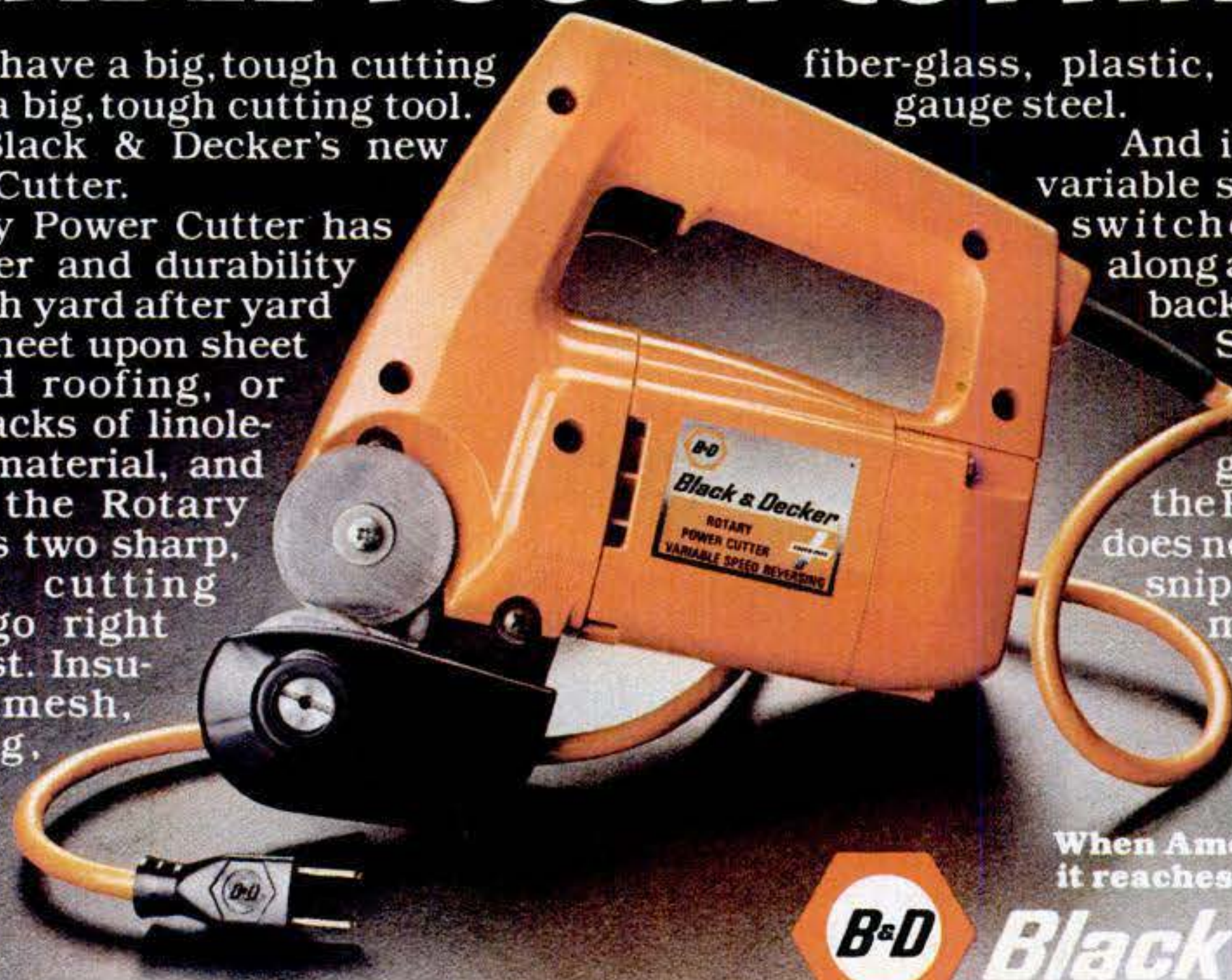
The Rotary Power Cutter has the horsepower and durability to slice through yard after yard of carpet, or sheet upon sheet of corrugated roofing, or stacks and stacks of linoleum. Name a material, and chances are the Rotary Power Cutter's two sharp, self-feeding cutting wheels can go right through it, fast. Insulation, wire mesh, asphalt roofing, heavy canvas,

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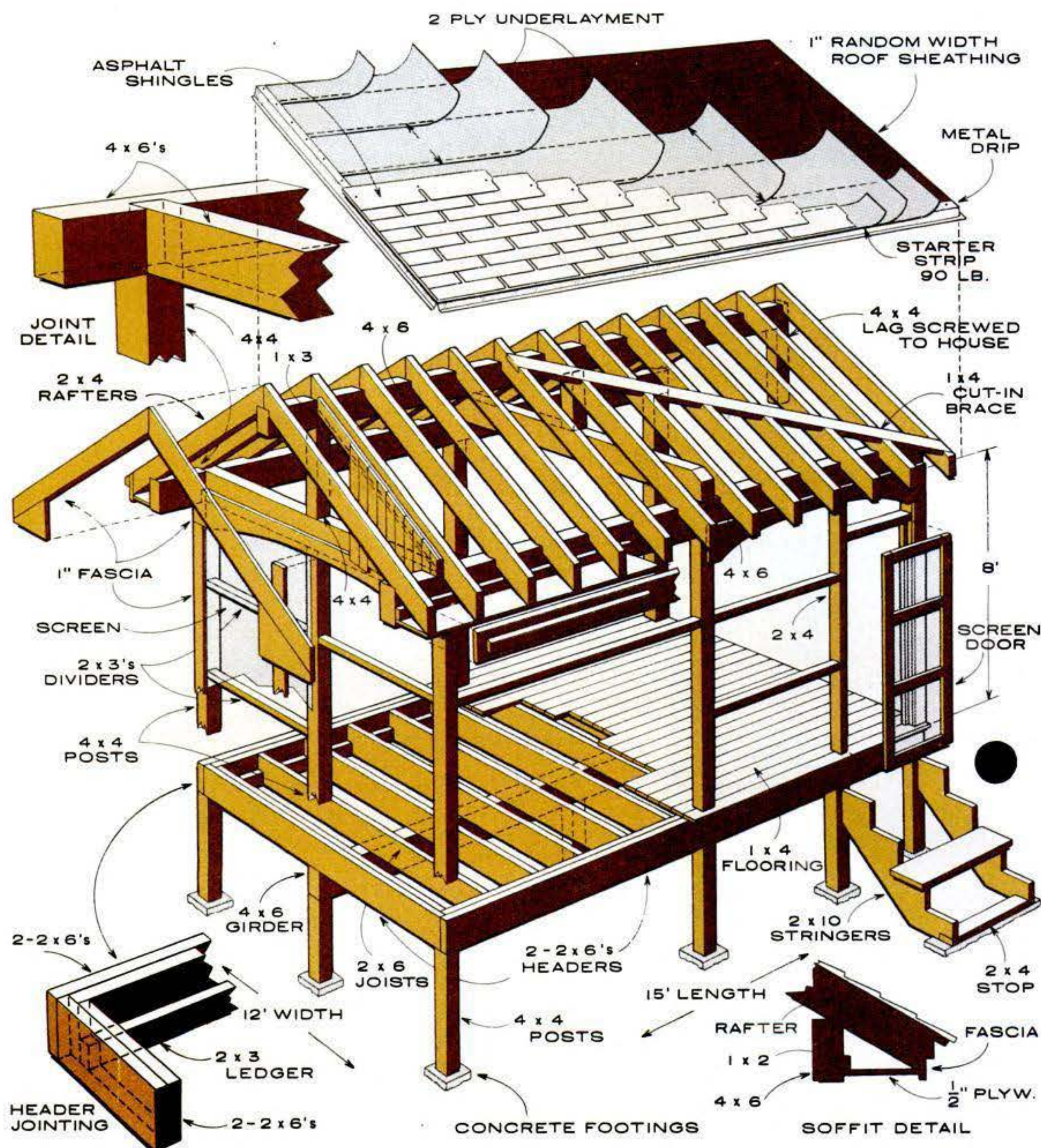
When America has a job to do, it reaches for Black & Decker.



Black & Decker

Add-on porch

[Continued]



Two 1x4 braces were notched into the rafters (drawing left) and underside of the 2x6 deck frame (not shown) at 45-degree angles, to prevent sway and eliminate bracing on wall posts. The joist and rafter adjacent to the house were lag-screwed into the house's framing without removing any siding (in this case, shingles). Screening was stapled across the underside of the joists to keep bugs and birds out. Topsoil was removed and the entire underporch area was covered with gravel. V-groove siding (see above) was added to gable overhang after screening and trim were installed.

The first floor joist was anchored to the house with lag screws. Two-by-six headers (with 2x3 ledgers nailed on) were set atop the posts, 1½ in. in from the outer faces. The remaining joists were then laid across the center 4x6 beam and spiked to the headers on each end. A second, outside header was nailed on after the joists were secured. The joists were covered with asphalt building paper, and the 1x4 fir decking laid.

The 4x4 posts above the floor of the porch were toenailed in place on the decking and temporarily braced. Horizontal plate beams were installed spanning the posts, projecting past the corner posts for a protective overhang. A 4x6 ridge beam was lifted into position, one end resting on a short length of 4x4 lag-screwed to the house, the other end supported by a 4x4 post set directly over the

center post at the end of the porch. A 4x6 crossbeam bridging the side-wall posts was added, and another short post lag-screwed between this crossbeam and the ridge beam.

The rafters were notched for the ridge beam and plate, and nailed in place. That ridge beam eliminated the need for collar beams or ceiling joists since there is no spreading force at the eaves. Rough-sawn, one-in. boards were used for roof sheathing.

Fascia boards were installed around the perimeter of the roof, and a ½-in. plywood soffit was nailed to the rafter ends. Asphalt shingles were laid on the roof with stepped aluminum flashing tucked up under the house siding for a leakproof joint.

Horizontal 2x3 rails spaced 30 in. on center were nailed between the posts. Screening 32 in. wide was stretched around the porch and sta-

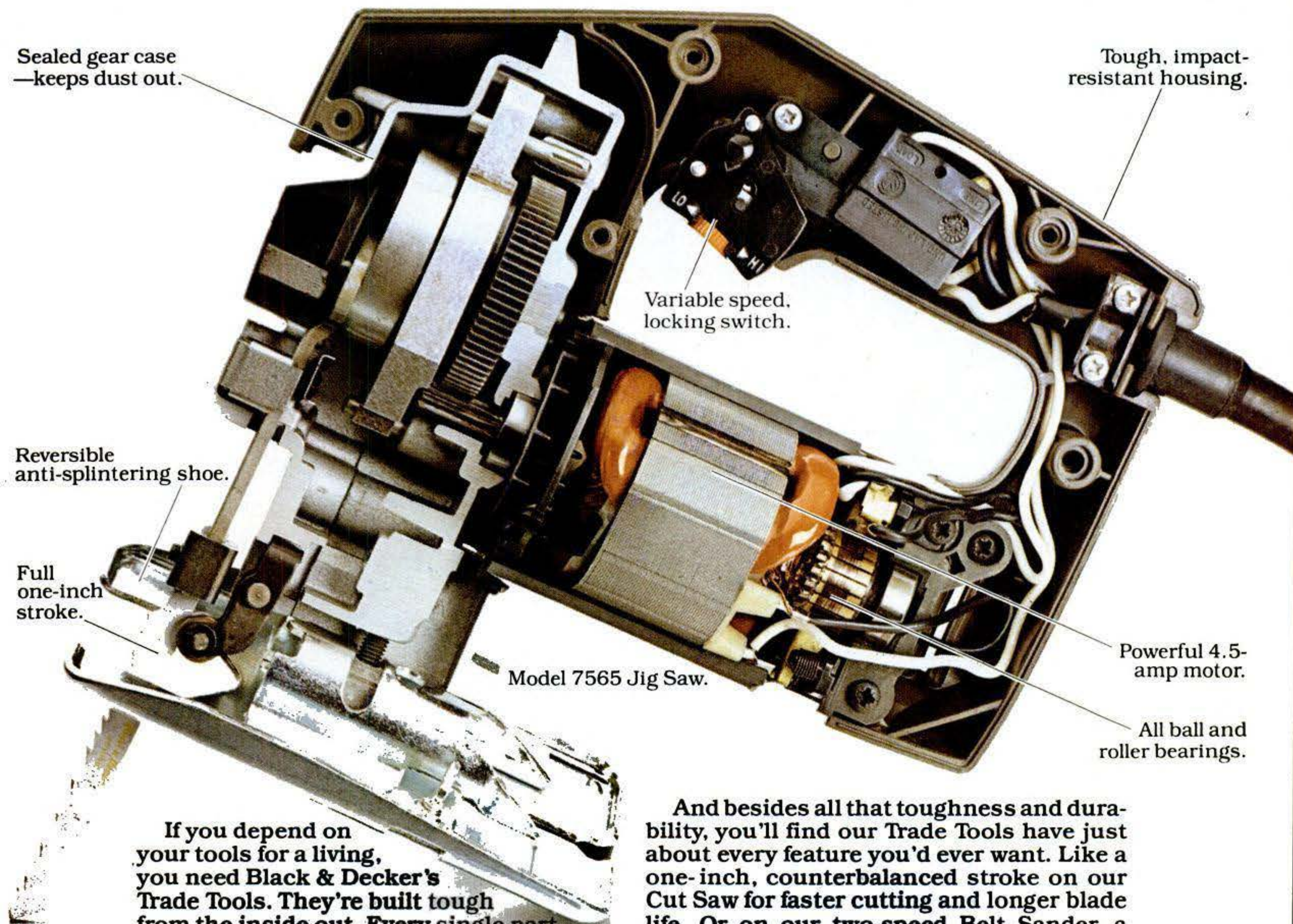
pled to the posts and rails. One-in. trim stock was ripped to the widths of the respective frame members and nailed to them over the screening. The upper section of horizontal trim (1x8) was shaped into arches between the posts. Prior to installing the screen, the entire porch was sprayed with color stain to match the house.

A screen door was made from 2x3 stock, with horizontal rails that lined up with those of the wall. From rough stock, I built the set of steps leading to the backyard.

With the porch closed in and bug-free, the dining-room window was removed and the opening enlarged to accommodate a frame and a pair of French doors.

In summer the screened porch is a cool, insect-free haven. In winter, the new doors offer a pleasant view to the diners inside.

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Octagon

with simplified roof

By AL LEES

Everybody loves an octagon—especially as the shape for a home in the wilds. Eight outside walls mean eight options for framing dramatic views. But there are two problems with the shape. When it comes to partitioning the interior into convenient rooms, an octagon is almost as tough as a dome: You end up with pie-wedge rooms. An even greater problem is in framing and decking an eight-plane roof. It's just not a job for a novice carpenter. And you might not even be able to find a local pro to build such a roof for you, out in the boondocks.

Enter *our* Octagon. In cooperation with Western Wood Products Assn., Home Building Plan Service's Jack Koenig designed us a modified roof scheme that not only solves the fuss and waste of the standard ridge-ring system, but cuts down on the volume of space *under* the roof that would have to be heated and cooled. Since all rafters are part of trusses, you don't end up with the vault-type ceiling the old system gave you. But you can now apply ample ceiling insulation and make some use of attic storage, which wasn't possible with the old system.

And look at the clever partitioning on the floor plans. A two-bath-plus-fireplace core brings logic to the plan, dividing traffic flow from the entry hall to the three good-size bedrooms and a spacious living/dining area that stretches over 38 feet. A door in the bedroom corridor can be closed to create a master-bedroom suite with a private bath large enough for one of the new spa tubs. (Note that since all these rooms are irregular, their given dimensions can't be used to figure square footage.) The kitchen layout retains conventional square corners for standard appliances.

There's another advantage to a level-ceiling octagon: Old-type ceilings, sloping toward the apex, were not only heat-wasters, they were also hard to partition against since each stud had to be cut to a different length. All studs for this house can be gang cut.

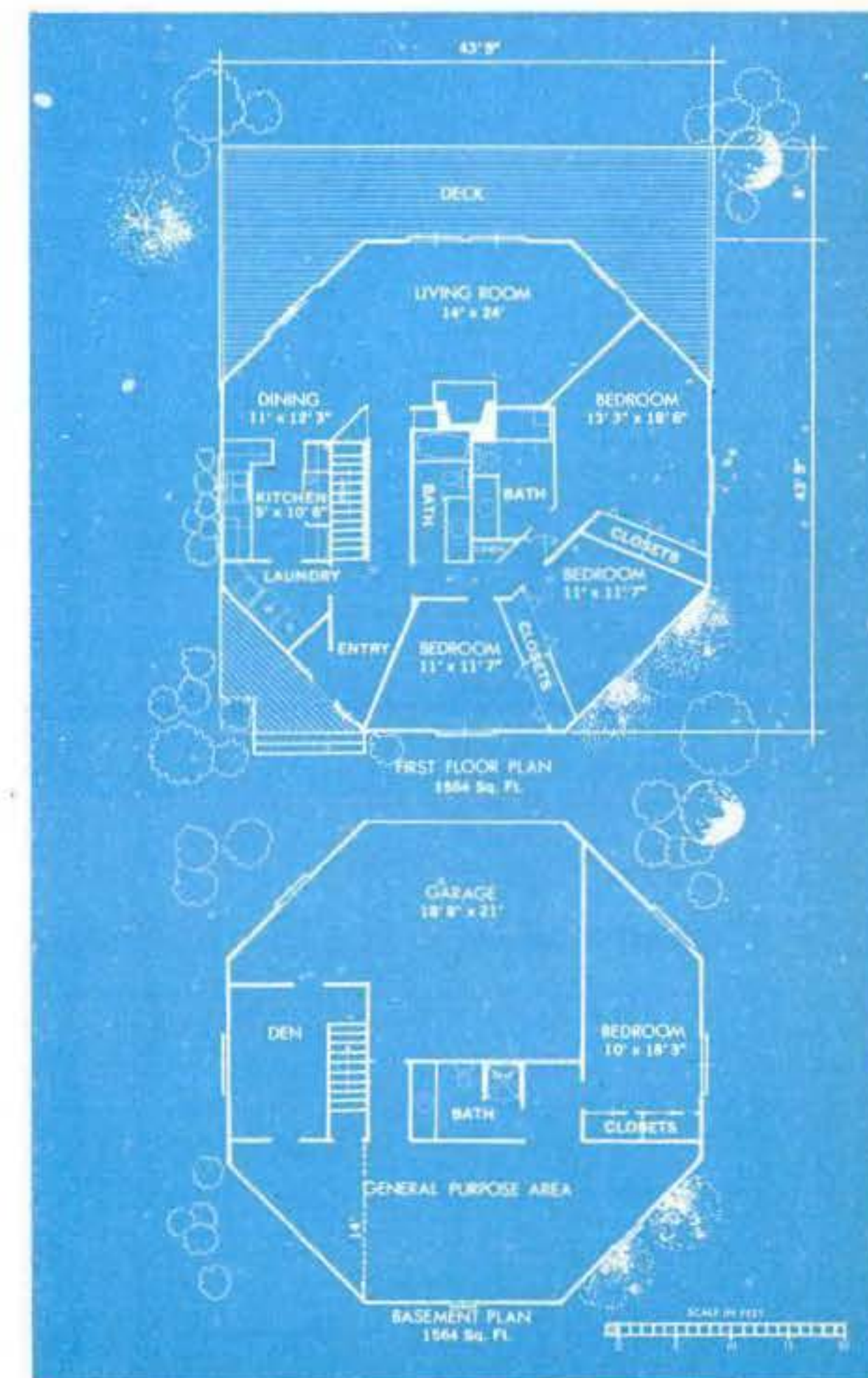
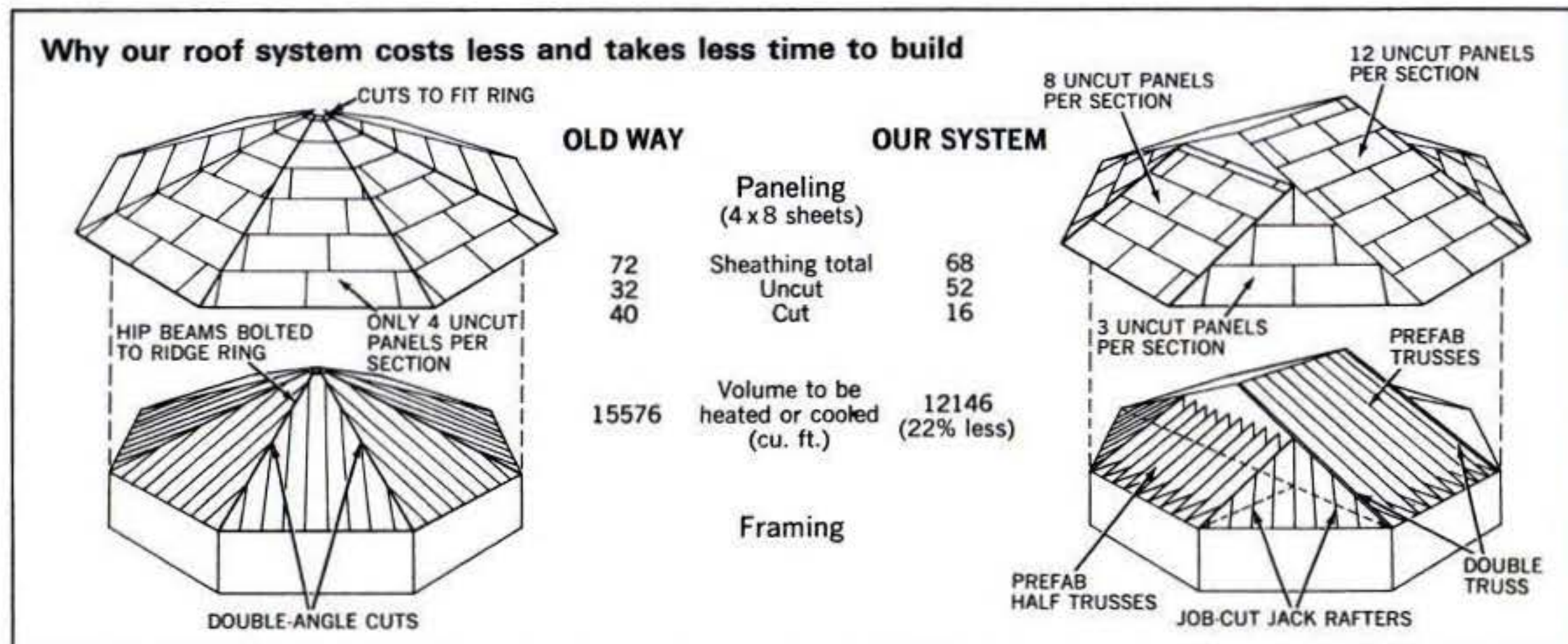
And there are few odd angles to the basement partitioning—which gives you a guest bedroom that doubles as a dressing room for swimmers (it has its own shower with a direct plumbing run from the back-to-back bathrooms above), a big garage with large storage corners, a cozy den or TV room with direct access to the main floor—plus an area that would be ideal for a workshop.

Vertical western-wood board siding unifies the exterior. The two broad roof planes offer better mounting for solar collectors than the multifaceted roof—and they're easier to shingle. They also let you install two louvered vents under the peak to carry off overheated air on summer days. That second flue is from a backup furnace.

In both our renderings, the driveway curls around from the entry side to bring the car in under a sweeping deck that's accessible from both living and dining rooms through sliding glass doors. But to adapt the plan to another site, you could relocate the garage door toward the entry, and jut the deck toward the water or cliff edge. **PS**

How to order plans for the easy Octagon

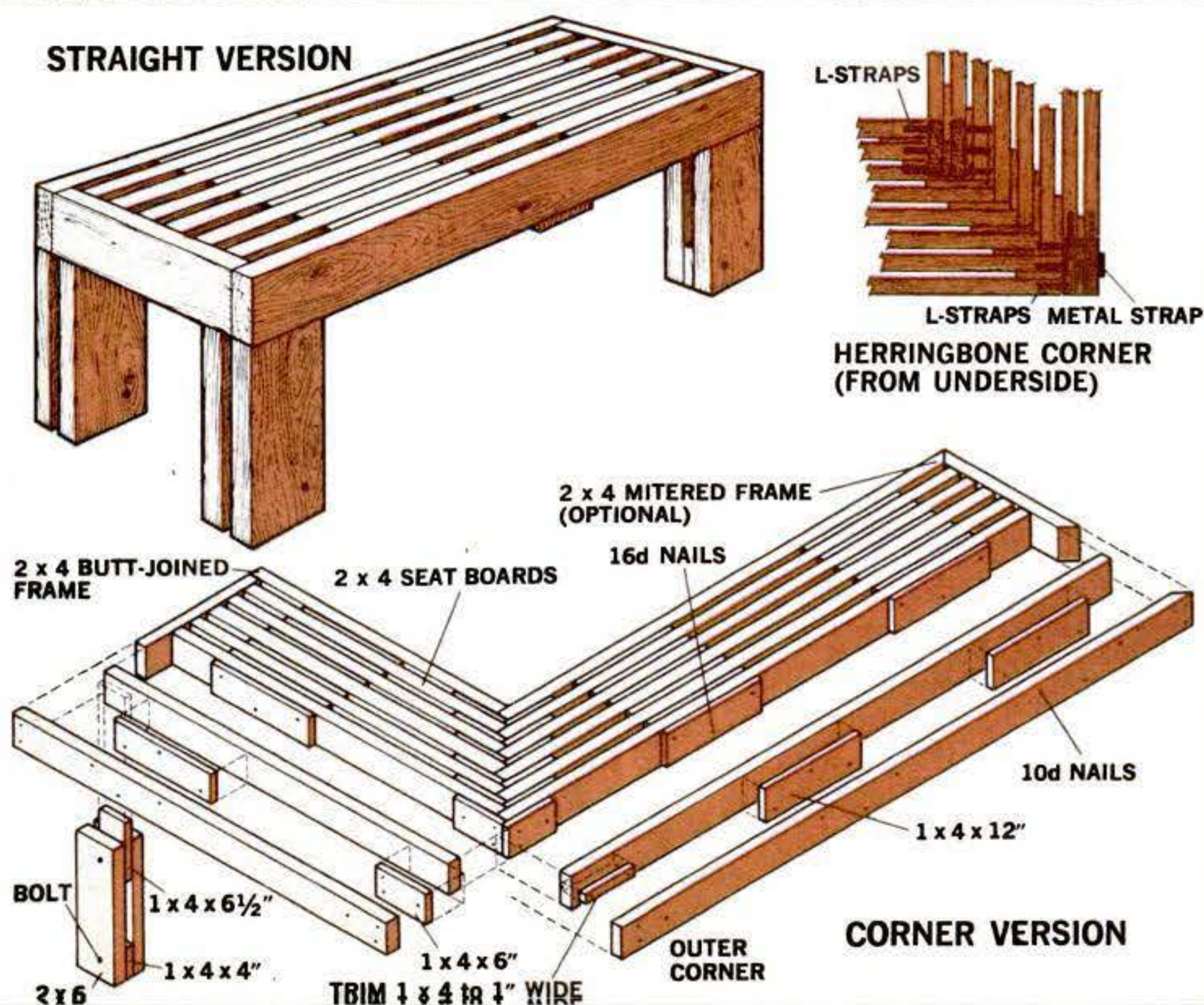
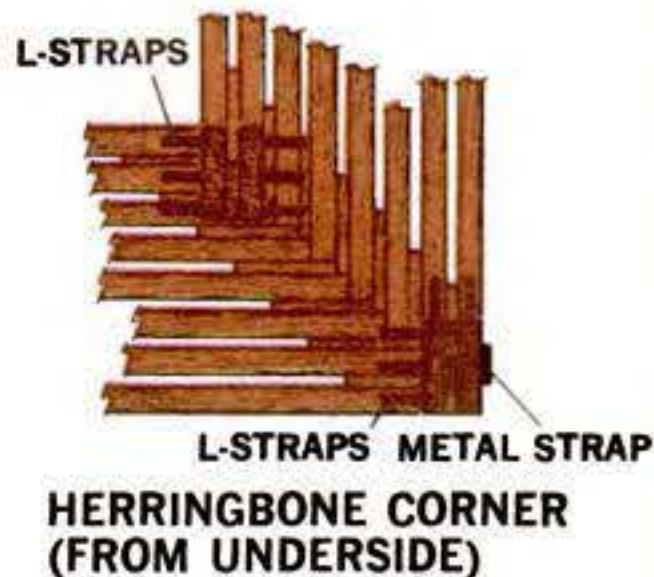
One set of professionally drawn plans for this house is \$95; four sets—for building, financing, and permits—are \$125. Plans will be reversed for \$20; building-materials list is also \$20. Specify plan 942-1. Orders and inquiries to Home Building Plan Service, 2235 N.E. Sandy Blvd., Portland, Ore. 97232.



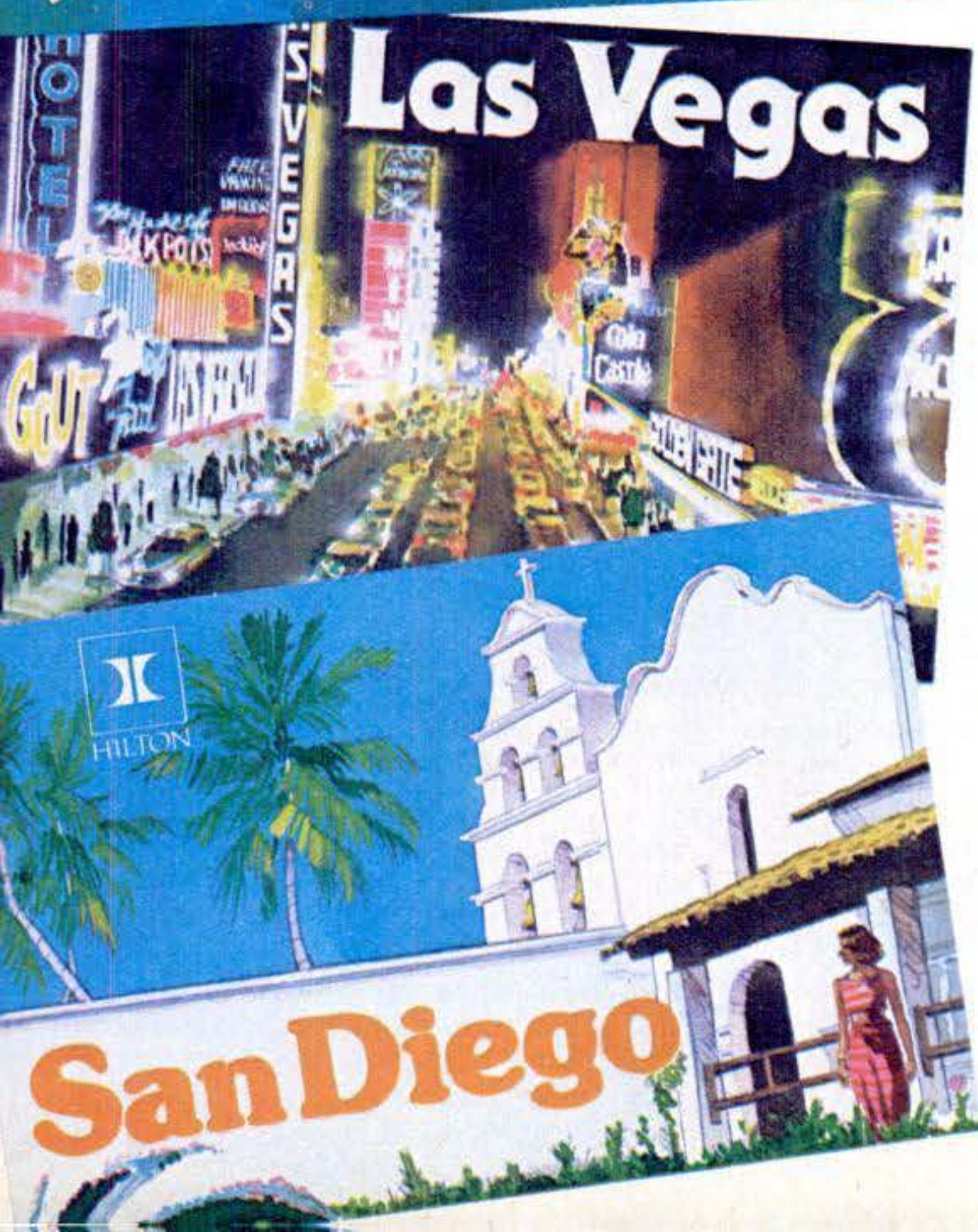
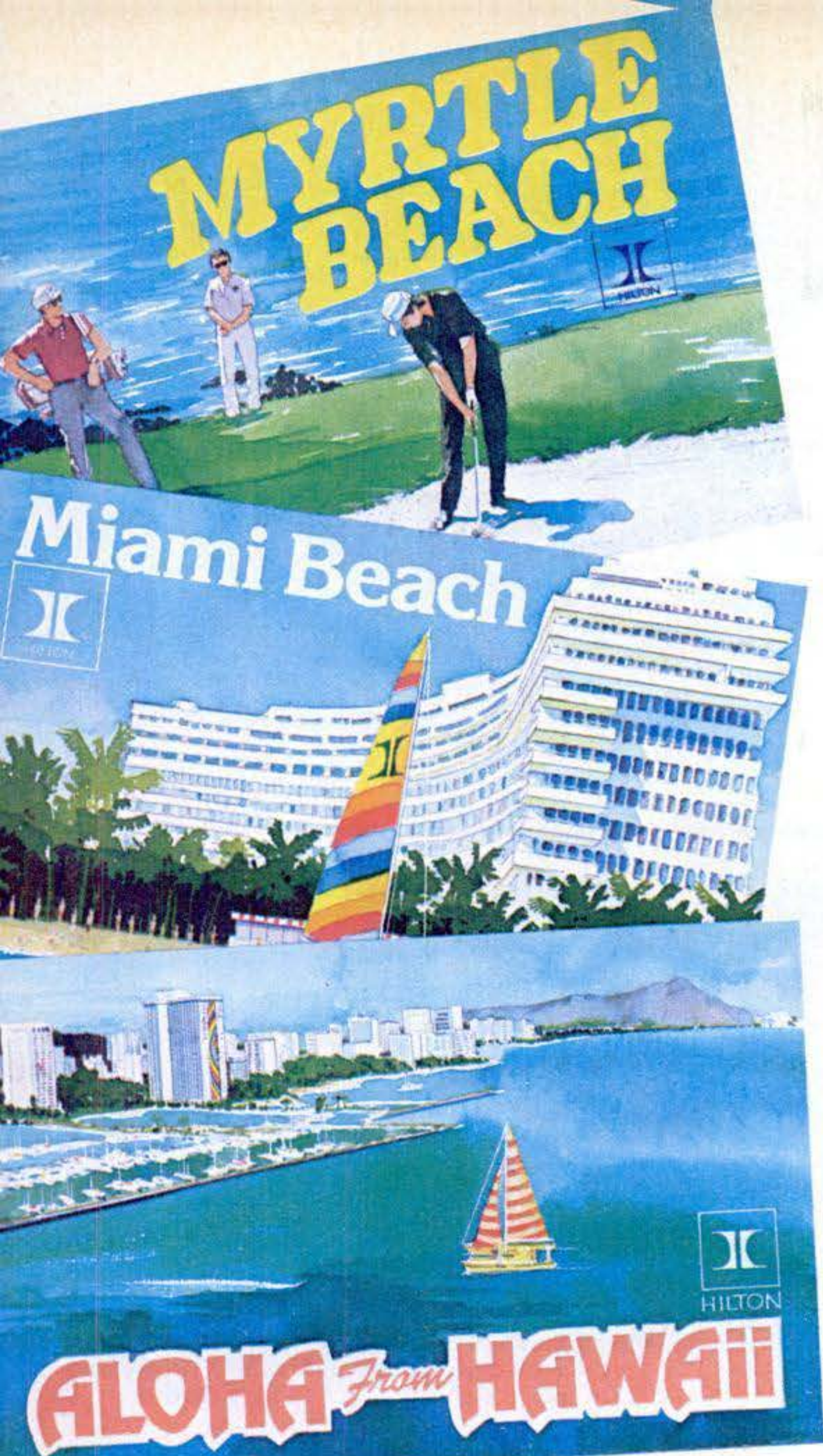


A photograph of a wooden deck with a built-in L-shaped bench. The bench is made of light-colored wood with slatted seating. On the left side of the bench, there is a small round table holding a glass and a book. A potted plant with yellow flowers sits on the deck to the right. The deck is enclosed by a wooden railing, and the background is a dense green hedge.

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SPRING
Home-
Improvement
Ideas

Beginning here: Our spring hardware section groups together information on home-maintenance tools, materials, and techniques that you'll discover at your local home center

Get things moving with **casters, glides, and wheels**

BY THOMAS H. JONES

Why break your back? If you have heavy furniture, shop tools, or yard equipment that must be moved occasionally—or frequently—you can outfit those items for easy mobility with the proper casters, wheels, and glides.

Start with furniture. Put your heavy pieces on casters and you not only make moving them a lot easier; you also save wear and tear on the floor and on the bottom of the furniture. Furniture casters are made in two basic styles: the traditional wheel and open ball-bearing type, and the modern ball style. The advantage of ball-type casters, besides appearance, is that they run quieter with less tendency to oscillate. But they cost more. The ranges of load ratings are similar for both styles, and both have stems that fit the same sockets.

Furniture casters are commonly available with two different mounting systems: stems or plates. A plate mounting is used to attach casters to the underside of flat surfaces—cabinets without legs, for example. Stem casters are mounted in sockets fitted into holes drilled in the bottom of wooden legs or sockets inserted into tubular steel legs. For the same wheel size and material, the two mounting systems are load-rated equally.

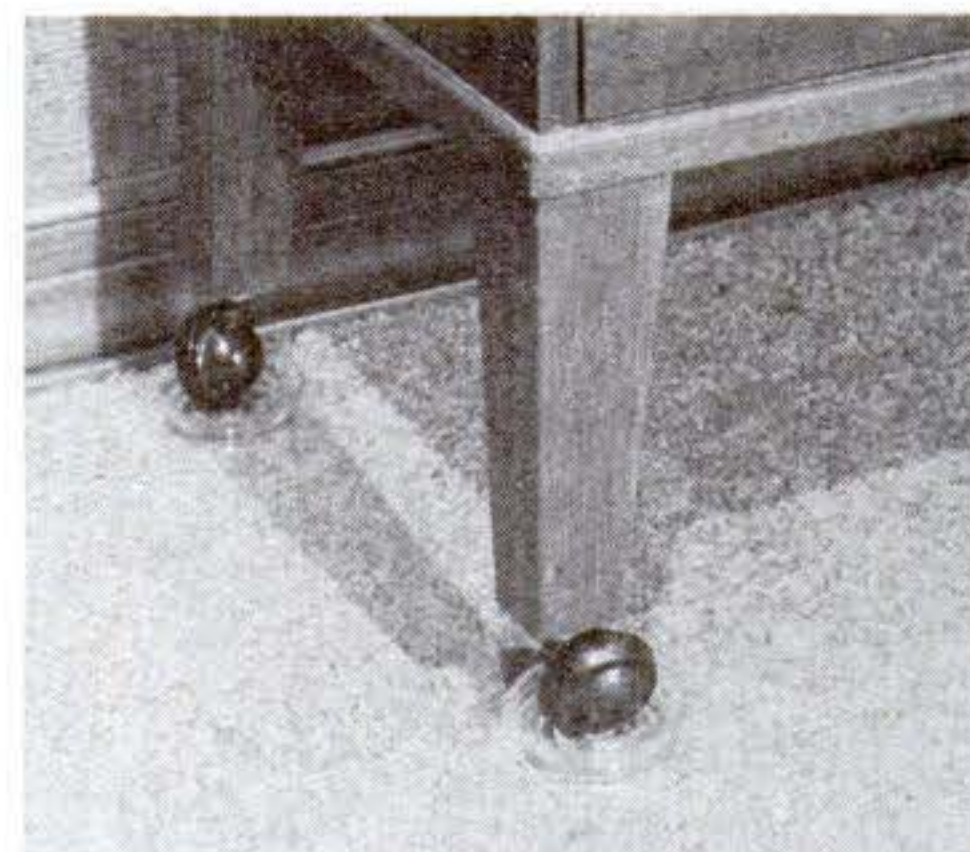
Most troubles with furniture casters are caused by using the wrong casters, either because they are inadequate for the load and service or wrong for the floor surface. Inexpensive utility casters cannot survive a lot of rolling around under heavy furniture. They are for very light loads or for use under seldom-moved heavier objects.

Match casters to floor

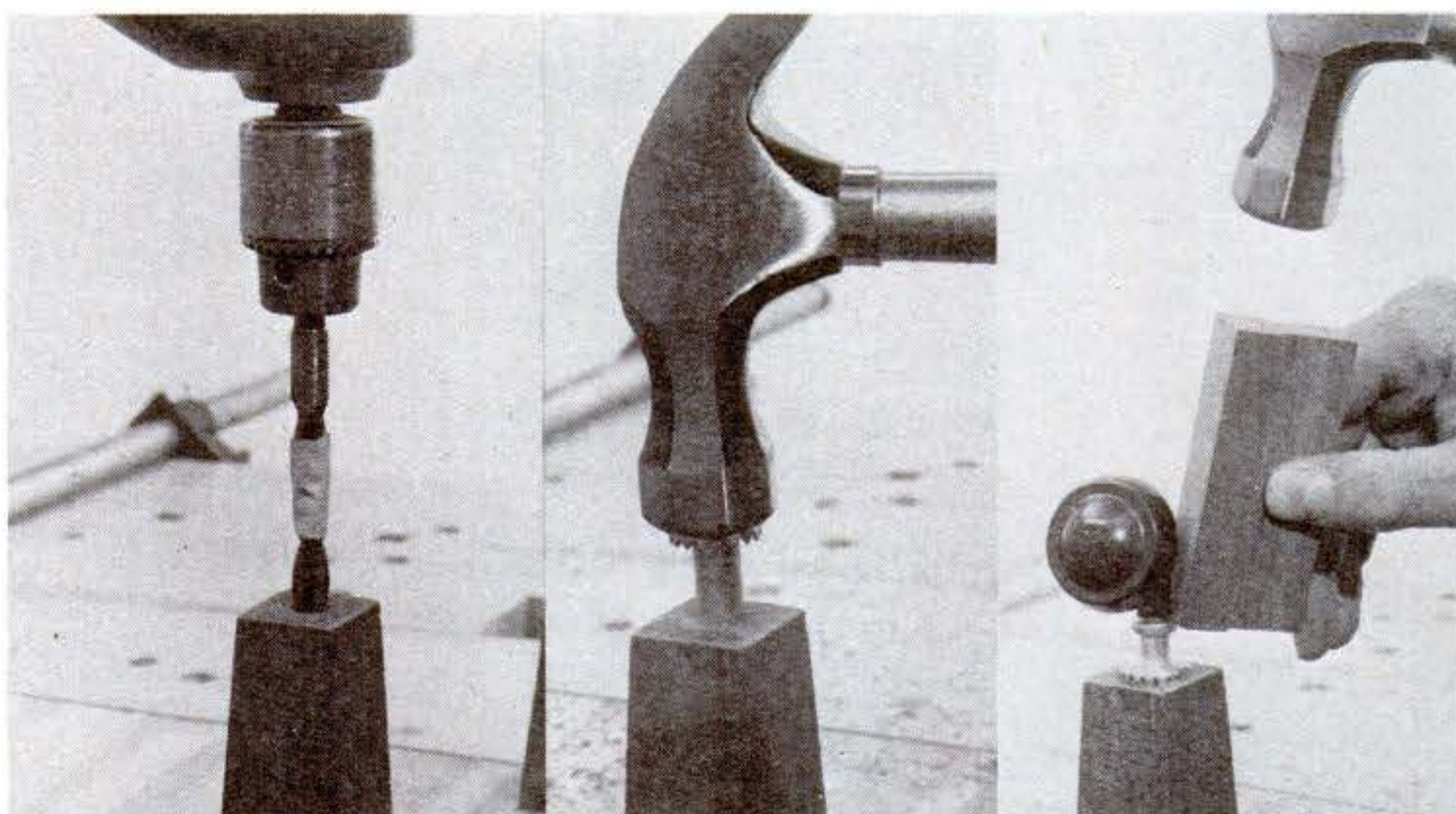
Load ratings indicate what the caster itself can survive, not what its tread under load will do to the floor. Furniture casters have either hard or soft treads. Hard-tread casters should be used if the furniture is to roll primarily across carpet, simply because the rolling will be easier. A soft-tread caster should be used on wood, concrete, resilient vinyl flooring, terrazzo, tile, stone, and brick floors—for two reasons.



Inexpensive utility casters should be used for light-duty tasks only, as on this tea cart. But they can be used on any kind of floor.



Small metal-tread ball casters will mobilize a bookcase on carpet, but should be put in plastic caster cups when bookcase is stationary.



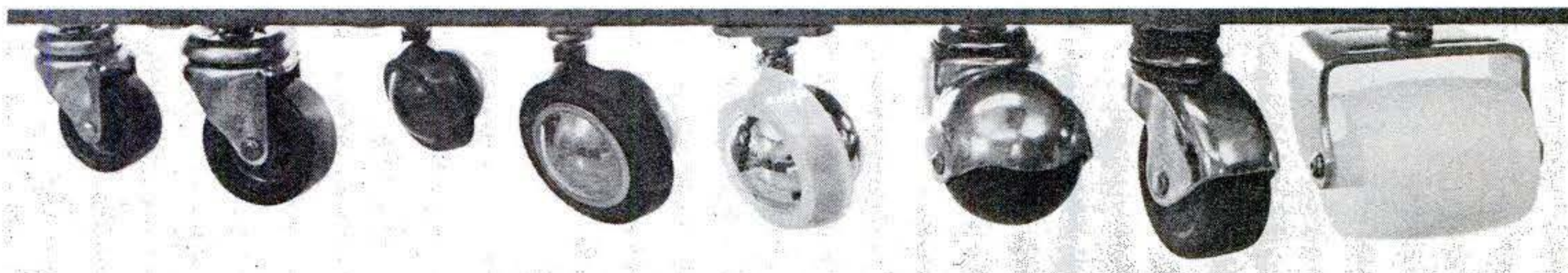
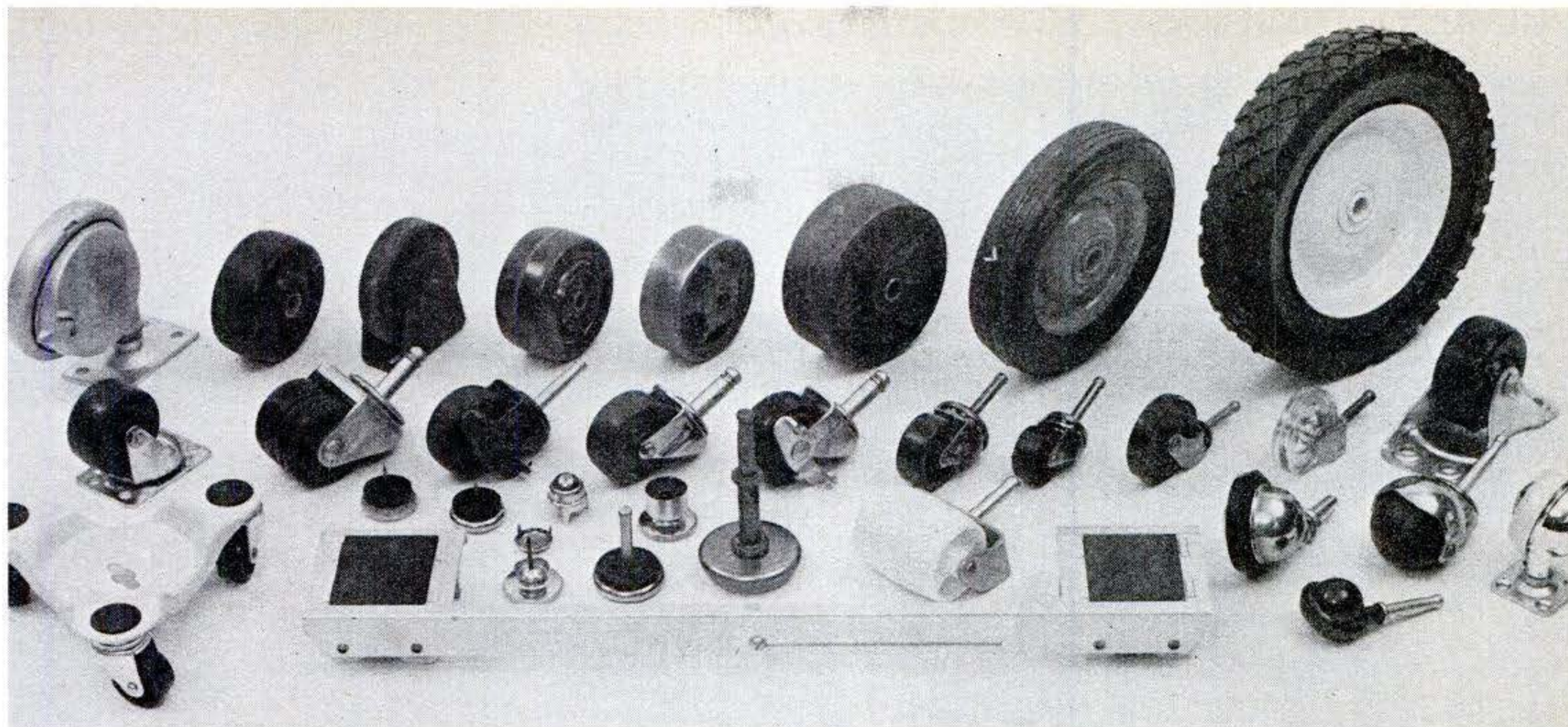
To install stem caster, drill hole to depth of socket, hammer socket in until serrated rim bites into

wood, and tap caster into socket, using scrap hardwood block on shoulder, as shown.

First, any debris on the floor—sand, pins, anything hard—will tend to be ground into the floor surface more by a hard caster wheel, or dragged around leaving scratches. Second, a hard wheel contacts only a very small area of the floor. Thus the per-square-inch load can be much higher than the wood or resilient flooring can withstand without denting. A soft wheel doesn't

dent the floor under the same load because the bottom of the wheel flattens, providing a bigger footprint.

Caster cups can be put under casters, either the hard or soft kind, to reduce the load when the furniture is stationary. That's when damage to the floor is most likely to occur. Or you can use glides instead of casters.



Casters, glides, wheels, and dollies are available in many types, sizes, and styles (top photo). Lower photo shows furniture casters (from left): two traditional casters with hard-plastic wheels; three ball-type—metal thread

for carpet, rubber for wood floors, all-plastic for carpet (white ring is removable for wood-floor use). Next: hooded soft-rubber casters, ball and traditional; and bed roller.

Glides

Glides give better protection for your floors when the furniture is in place, but they don't make moving it as easy as casters do. Like casters, glides protect the bottom of the furniture leg. They're available in a wide variety of types and sizes. The best choice depends on the floor surface, the weight of the load, and the method of attachment.

The larger the diameter of the base of the glide, the less floor marking you'll have, and the easier it will be to move the object. As a general rule, for heavy furniture and equipment, use as large a glide as you can without detracting from the appearance.

Glides are most important when cushioned vinyl resilient flooring is involved. The squared-off ends of wood furniture legs damage such flooring quite easily, making sharp-edged depressions that can be permanent. The rounded edges of glides spread the load more evenly so it won't exceed the load rating of the flooring. The load rating of cushioned vinyl flooring ranges from 50 to 75 psi; glides should be sized accordingly.

The bases of glides are commonly nylon, phenolic resin, or nickel steel. Use any of these on carpet, resilient flooring, or wood. Avoid steel bases on masonry floors, because in time they will become scratched, and then scratch the floor. Use either of the plastics, but recognize they will wear on any masonry floor. Glides with a carpeted base are also available. These offer the best protection for wood floors, but should be replaced when they become glazed. Glides

with rubber cushions reduce moving noise and help absorb shocks, especially when used on metal furniture or equipment.

Glides are generally nailed to wood furniture. Slip-on mountings are available for tubular metal legs. For heavy-duty applications, use glides with threaded stems, or use those with the same stems as used on furniture casters.

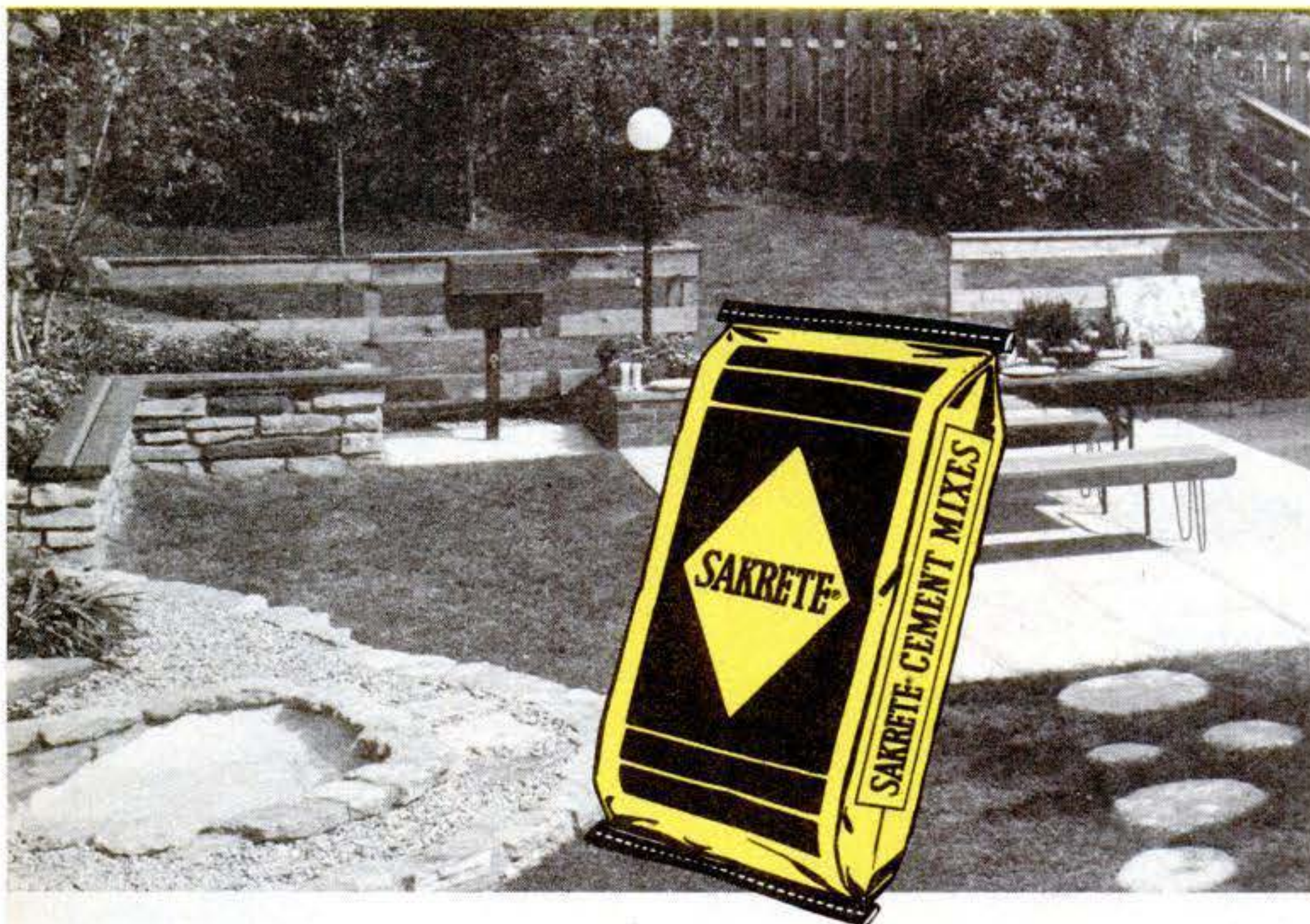
A word about new furniture: Most wood furniture comes with small steel domes on the ends of the legs. These do a good job of protecting the furniture legs during shipping and store display, but they can make a mess of your floor. Remove such glides from furniture that will be placed on wood or resilient flooring and sand the ends of

Continued

Furniture and shop casters

Type	Use	Wheel size	Load rating (lbs.)	Tread or wheel material						Comments	Approx. list price (\$)
				Plastic	Hard rubber	Soft rubber	Metal	Stud mounting	Mounting plate		
Utility casters	Serving carts, TV stands, or intermittently moved light furniture	1 1/4"	25	•				•		Black or white wheels	2.80 (4)
		1 1/2"	40	•				•		Black or white wheels	3.10 (4)
		2"	35	•				•		Black, white, or clear	3.20 (4)
		3"	35	•				•		Black, white, or clear	2.60 (4)
Standard-duty casters, traditional design	All furniture; carpet or resilient floor only	1 1/4"	40	•					•		2.60 (4)
		1 1/2"	55	•					•		3.10 (4)
Heavy-duty casters	Heavy furniture, moved frequently	2"	80		•	•		•	•	•	11.40 (4)
	Pianos, shop equipment	(2) 2"	150			•		•	•		21.00 (4)
	Pianos, shop equipment	(2) 2"	200					•	•		21.00 (4)
	Bed roller	2"	125	•	•			•		White; clear. Carpet only	7.00 (4)
Shop casters	Shop equipment, dollies	4"	200		•	•		•	•	•	11.00 ea.
		4"	300		•	•		•	•	•	11.00 ea.
		5"	325		•	•		•	•	•	24.70 ea.
		5"	450		•	•		•	•	•	24.70 ea.
Three-wheel dolly	Heavy furniture	(3) 1 1/4"		•							6.00 (2)
Refrigerator dolly	Refrigerators, file cabinets	(16) 1 1/4"	110	•							6.00 (2)
Ball casters	All furniture, office, shop equipment	2"	45	•				•	•	Plastic body	6.00 (4)
		2 1/2"	60	•				•	•	Plastic body	4.20 (4)
		1 1/2"	40					•	•	Ferrule mounting	8.50 (4)
		1 3/4"	75					•	•		9.40 (4)
		2"	75					•	•		12.00 (4)
		2 1/4"	75					•	•		13.00 (4)
		2 1/2"	100					•	•		14.00 (4)
		3"	100					•	•		15.00 (4)
Canted-wheel casters	All office, shop equipment	4"	135		•	•		•	•		14.00 ea.
		5"	150		•	•		•	•		18.00 ea.

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Build a backyard as beautiful as this. It's easy and economical ... when you do it yourself ... with SAKRETE Mixes. You'll save up to 80%, and you'll increase the value of your home.

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with the professional look of the one shown here.

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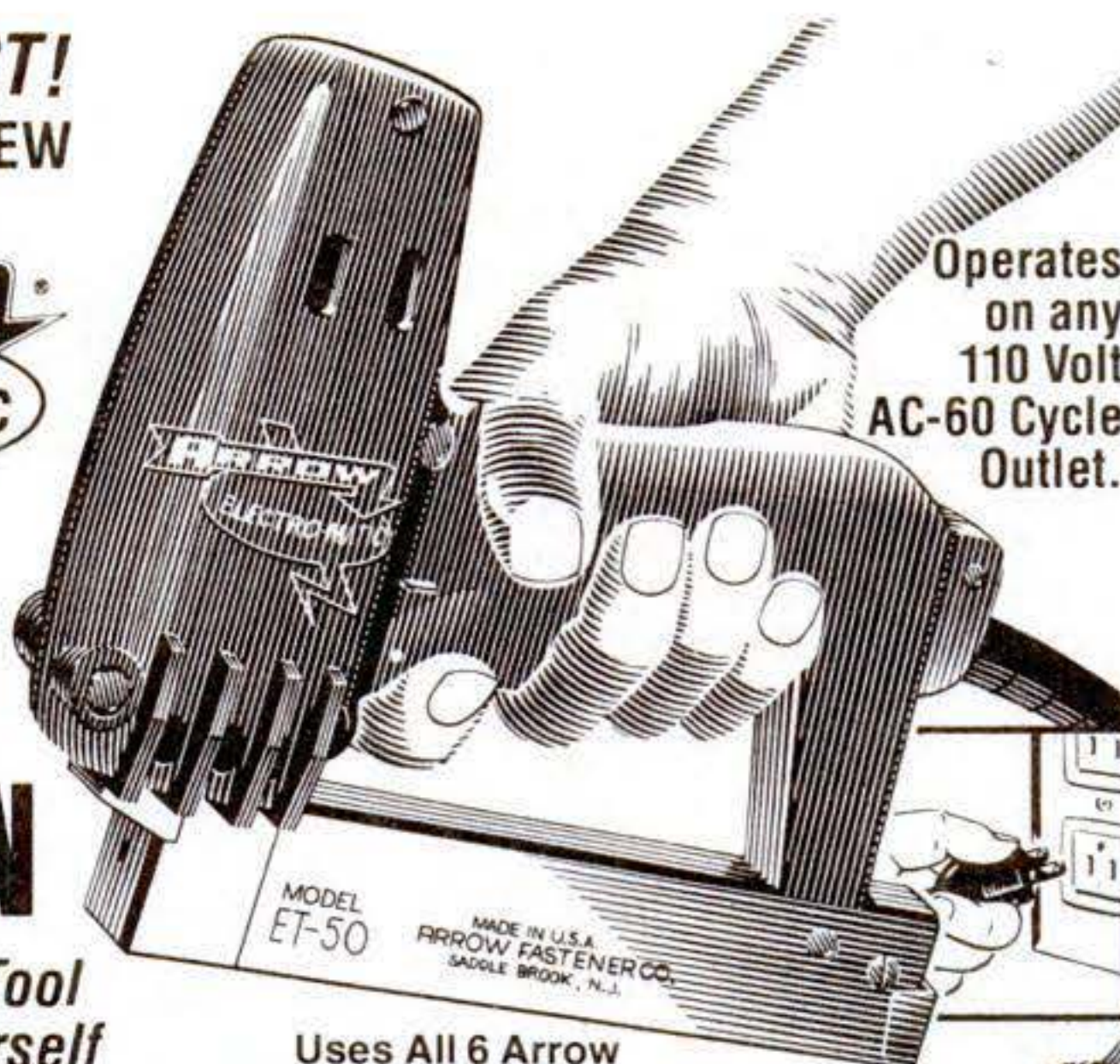
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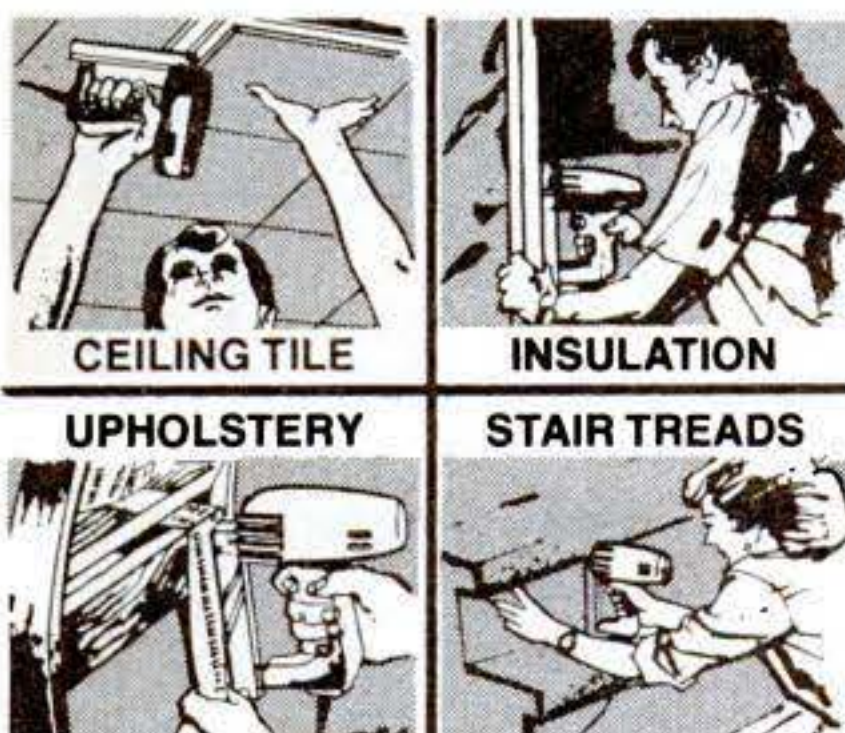
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Lightweight yet rugged ... the versatile, new **ARROW ET-50 ELECTRO-MATIC** is designed to fulfill a man's need for a staple gun powerful enough to drive staples into hard woods for heavy duty work! Yet, so easy to operate, even for a woman's delicate hand!

Solid-state circuitry, on/off safety lock one-piece solid steel base — plus many other ultra-modern features make the **ARROW ET-50 ELECTRO-MATIC** truly a unique low cost/high value electric staple gun!



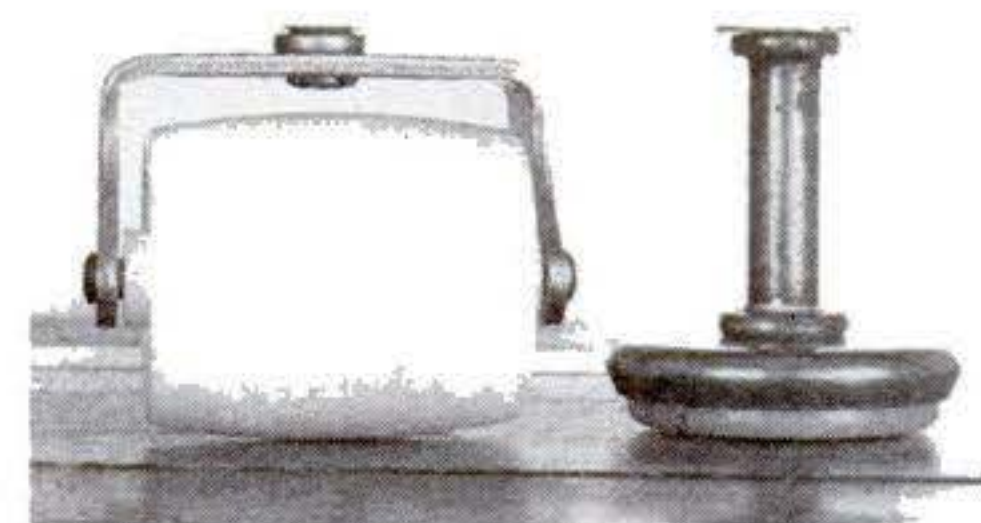
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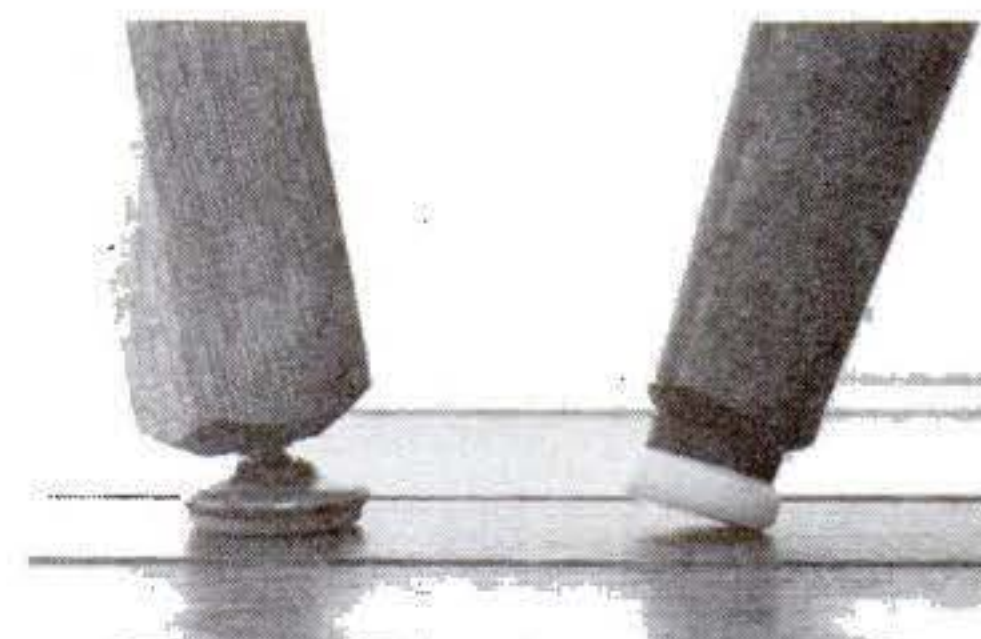
Available at All Leading Hardware,
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Stores Everywhere.

Casters, glides, and wheels

[Continued]



Bed roller, left, makes only spot contact with hard floors; it will leave circular dents and tracks. Use rollers for carpeted floors only. The **bed glide**, right, spreads weight over a broader area and prevents damage to hard floors. Use of glides is especially important on wood floors.



Angled furniture legs need glides with ball socket (left) so glide will sit flat on floor. Standard glide (right) contacts only a tiny area.



Refrigerator dollies are handy for moving heavy objects, but do *not* leave refrigerator on dolly; that can dent cushioned vinyl flooring and may even cause operating problems.

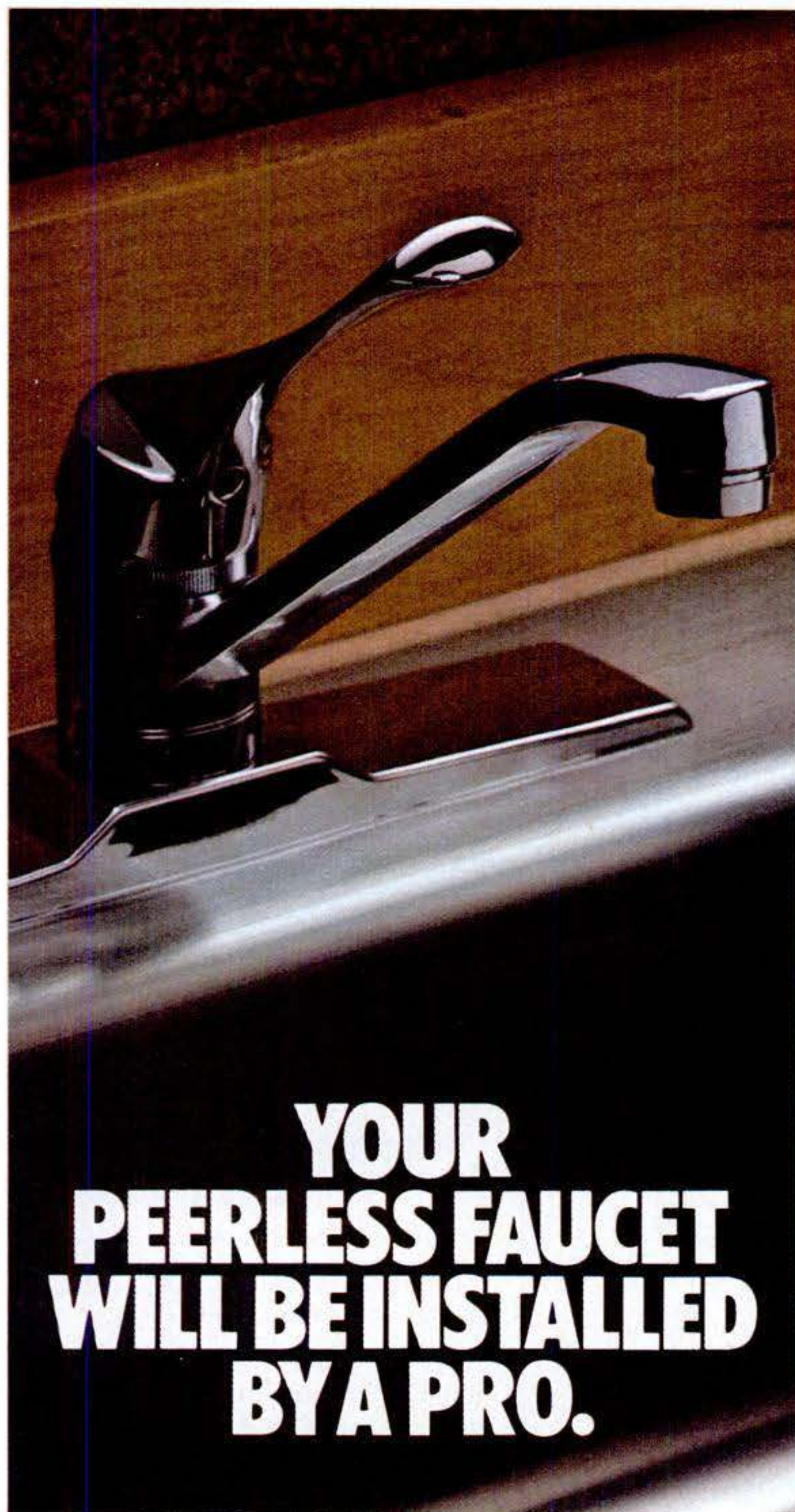
the legs smooth. If the piece will sit on carpet, the steel domes will do no harm.

Shop casters

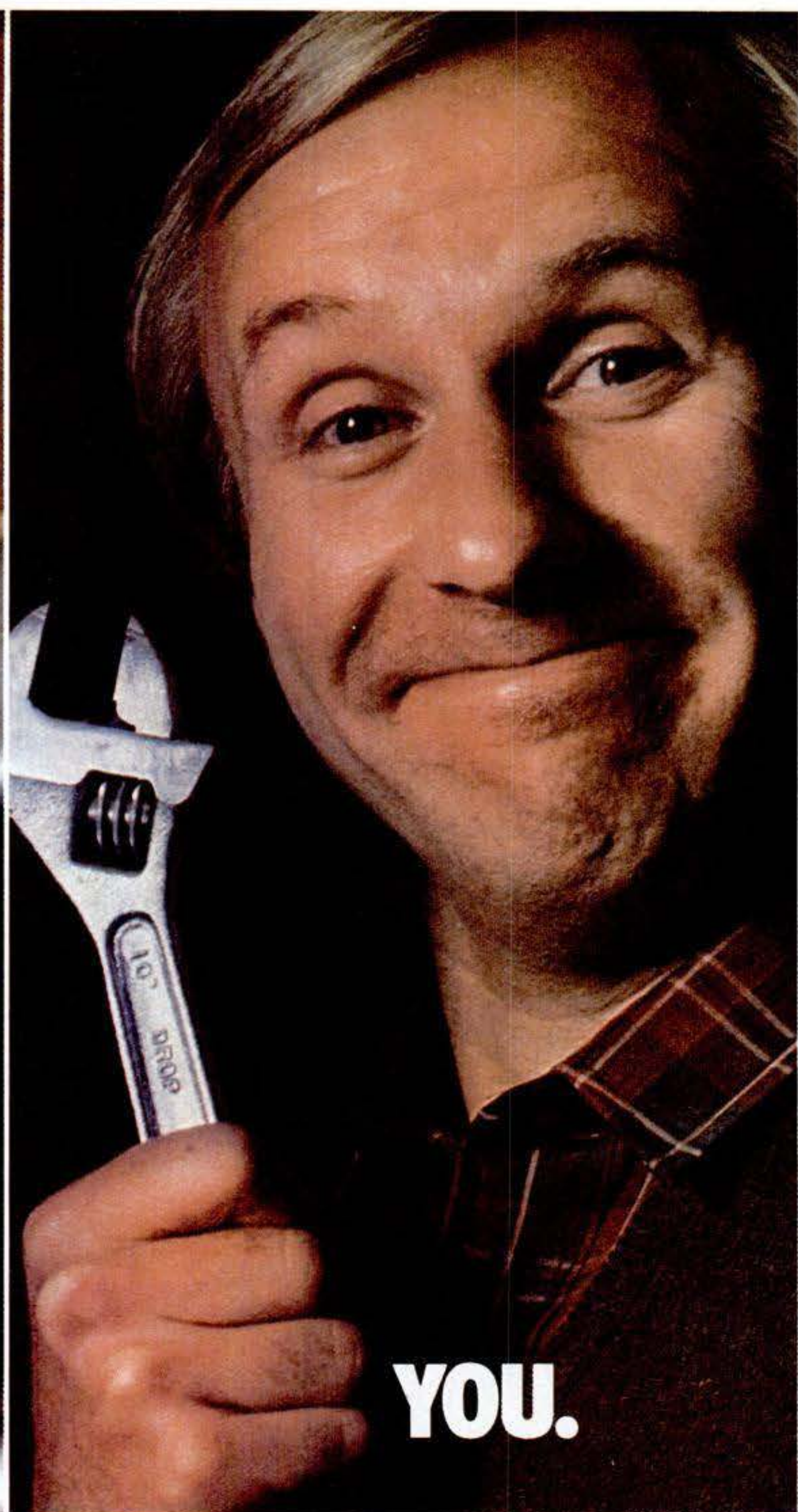
Getting your shop tools up on wheels has many advantages. In small shops, tools can be moved about to make room for big workpieces. (I have a small tool cabinet on casters that is exactly the same height as my workbench. It can easily be positioned to support the end of anything being cut or assembled.) Cleanup is also easier when you can roll everything to one end of the shop for a clean sweep-down.

Industrial casters are what you need to support heavy shop tools. The first step in selecting the right size and kind is to look at the floor: What kind is it and how clean do you keep it? All caster ratings are given for clean, smooth, level hard floors. Rolling over litter on a hard floor with hard wheels can produce impact shock loadings several

Continued



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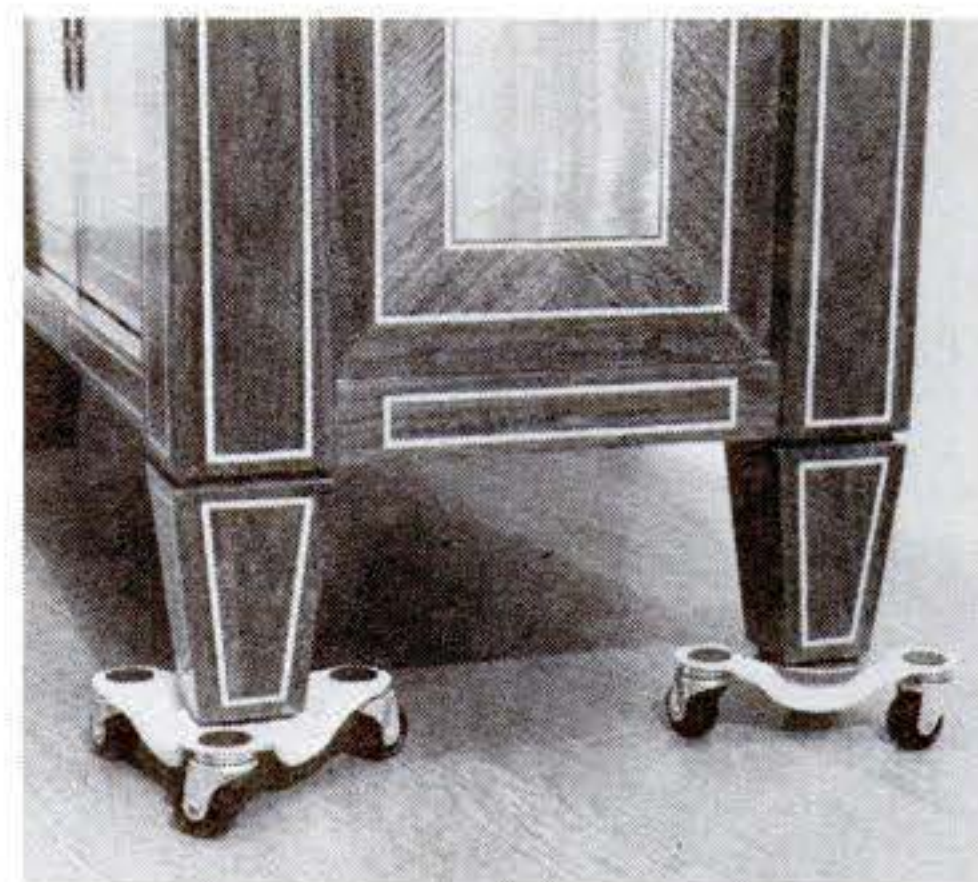
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An **EMHART** Unit

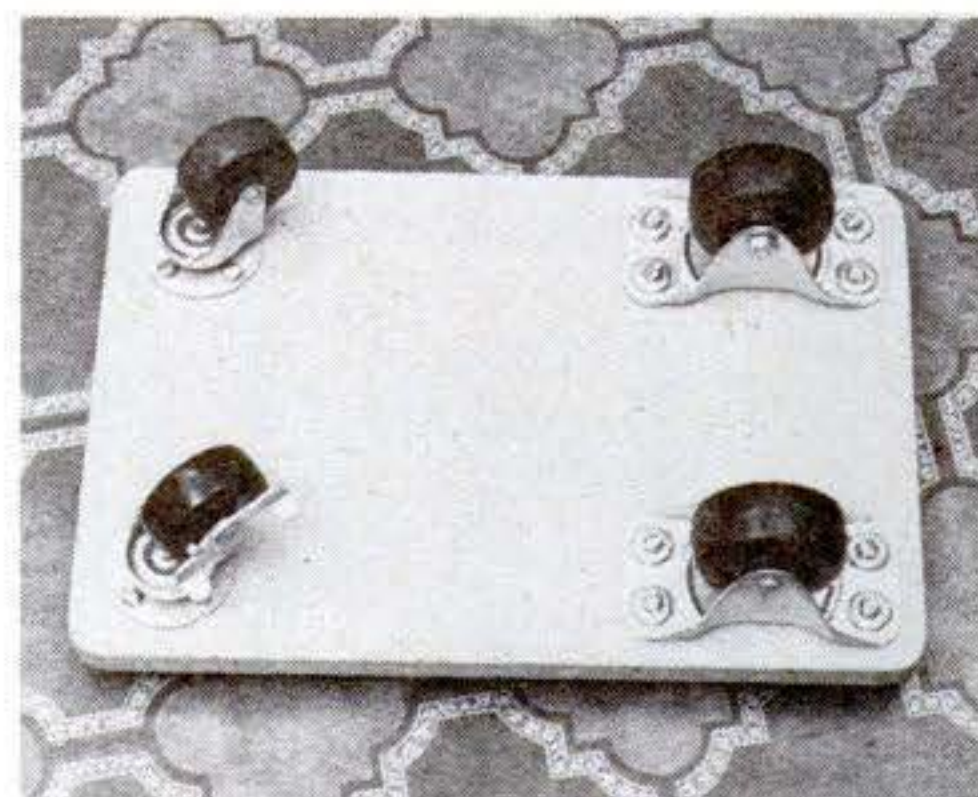


Casters, glides, and wheels

[Continued]



Three-wheel furniture dollies: quick solution to moving heavy furniture. Square legs of furniture can be propped up on jar lids to clear circular depressions; top pads (black disks) allow dollies to be used under flat surfaces.



Make your own dolly with two rigid and two swivel casters (as shown) for use when you need directional control more than maneuverability. Otherwise, use four swivels.

times the nominal load and increase the rolling effort as much as five times. Rolling effort is the pounds of push or pull required to move a load at a steady two mph once you have it moving. Starting effort on a clean hard floor is about 20 percent higher—much higher on a littered floor. Under the same load and on the same floor, rolling effort is higher for small wheels than it is for large ones.

The next step in caster selection is to determine the load—tool, cabinet, and everything in or on it. If you'll have four wheels on the floor, divide the weight by four, but make allowances. If the floor tends to be littered (be honest), double the load; casters can break when overloaded. For occasional moving around the shop, rolling effort can be ignored.

Tools are sometimes set up with only two casters at one end. When moved, the load is essentially all on the wheels, so the total load should be divided by only two to determine the caster capacity needed.

Heavy tools should not be left standing on casters on a resilient floor. The concentrated weight can cause permanent dents. Solution: retractable casters. They're available from Sears, Rockwell, and other suppliers.

Having your workbench on casters can be handy, but the load should be off them

Continued

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"It turned out beautiful. We love it and so do the neighbors.

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Thank you, Mr. Hertel.

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OLYMPIC LATEX STAIN.

Casters, glides, and wheels

[Continued]

when you use the bench for hammering. Few casters can take the impact, and they do not provide as solid a base for the bench as four flat feet on the floor.

Wheels

Wheels for shop (industrial) casters are commonly available in four materials: metal, soft rubber, hard rubber, and reinforced phenolic resin.

Metal wheels have the highest load capacity and are the easiest to roll. They can be used on rough and littered floors where other wheel-tread materials would be destroyed. But they will damage almost any floor. Small metal wheels are made of pow-

dered iron, compacted and sintered, and are as strong as cast iron. Wheels in the four- to eight-inch range are made of semi-steel. Larger wheels are made from forged steel.

Wheels molded of phenolic resin impregnated with macerated canvas have a load capacity almost equal to metal wheels. They roll easily, they're quieter running, they do less damage to floors, and can be used on any smooth hard surface. These wheels are made only with roller bearings—and they're expensive.

Hard-rubber molded wheels are made with sleeve and roller bearings. They have about 70 percent of the load capacity of

metal or impregnated-phenolic-resin wheels. They can be used on any smooth floor. They do not leave marks and are resistant to oil, water, and most acids. These are the least expensive caster and dolly wheels you can buy.

The cushion-rubber tread of soft-rubber molded wheels gives maximum floor protection and the quietest operation. However, they can leave black marks that are difficult to remove from vinyl resilient flooring. These wheels cost about the same as hard-rubber wheels, and they are the least durable.

Wheels can be purchased separately for replacements in industrial casters and other applications (see table). Besides these wheels, there are lawn-mower wheels and a variety of pneumatic and semi-pneumatic tired wheels.

Lawn-mower wheels have solid rubber treads on steel hubs, and load ratings that make them useful for yard-material handling carts. Since the wheels have integral ball bearings, you mount them directly on an axle.

Semi-pneumatic rubber-tired wheels are of two kinds: One has the cross section of a tire but is not pressurized; the other is made of sponge rubber. Both are lightweight, low-cost, have good load cushioning, and punctures do not impair performance.

Pneumatic-tired wheels require air pressure to carry the load and provide cushion-

Rubber-tired wheels—many kinds to choose from

	Wheel size (in.)	Tread	Tire type	Hub length (in.)	Axle diameter (in.)	Bearing	Load rating (lbs.)	Tire size	Ply	Price (\$)
Mower wheels, steel hubs	6 × 1.50	Rib	Solid	1 1/4	1/2	Ball	50			3.50
	7 × 1.50	Diamond	Solid	1 1/4	1/2	Ball	55			4.00
	8 × 1.75	Diamond	Solid	1 1/4	1/2	Ball	60			4.50
	10 × 1.75	Rib	Solid	1 1/2	1/2	Ball	80			6.00
	12 × 1.75	Rib	Solid	2 1/4	1/2	Ball	90			8.00
Hand-truck wheels, steel hubs	5 × 1.25	Smooth	Solid	1 1/4	3/8	Sleeve	200			3.50
	6 × 1.50	Smooth	Solid	1 1/4	3/8	Ball	300			7.50
	6 × 2.00	Smooth	Cushion	2 1/4	1/2, 3/4, 1	Ball	250			7.50
	8 × 2.50	Rib	Semi-pneu.	2 1/4	1/2	Ball	250			13.00
	10 × 2.75	Rib	Semi-pneu.	2 1/4	1/2, 3/4, 1	Ball	250			12.00
Utility and implement wheels	6 × 2.00	Rib	Semi-pneu.	2 1/4	3/8	Ball	200			13.00
	8 × 2.50	Rib	Semi-pneu.	2 1/4	3/8	Ball	180			17.00
Wheelbarrow wheels	16	Rib	Pneumatic	5	1/2	Ball	Not given	4.80/4.00-8	2	17.00
Utility wheels, 15-mph max. speed	8.4	Diamond	Pneumatic	2 1/4	3/8	Roller	260	2.80/2.50-4	4	16.00
	10.5	Sawtooth	Pneumatic	2 1/4	3/8	Roller	440	4.10/4.00-4	4	15.00
	12.5	Sawtooth	Pneumatic	2 1/4	3/8	Roller	560	4.10/3.50-6	4	18.00



Elmer's Carpenter's Wood Glue. How the pros make it look easy.

Grabs instantly.



Aligns easily.



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Elmer's Carpenter's Wood Glue is also sandable, paintable and resistant to gumming. What's more, its solvent-free, non-toxic* formula quickly washes off hands and wood with water.

Now what could be easier than that?

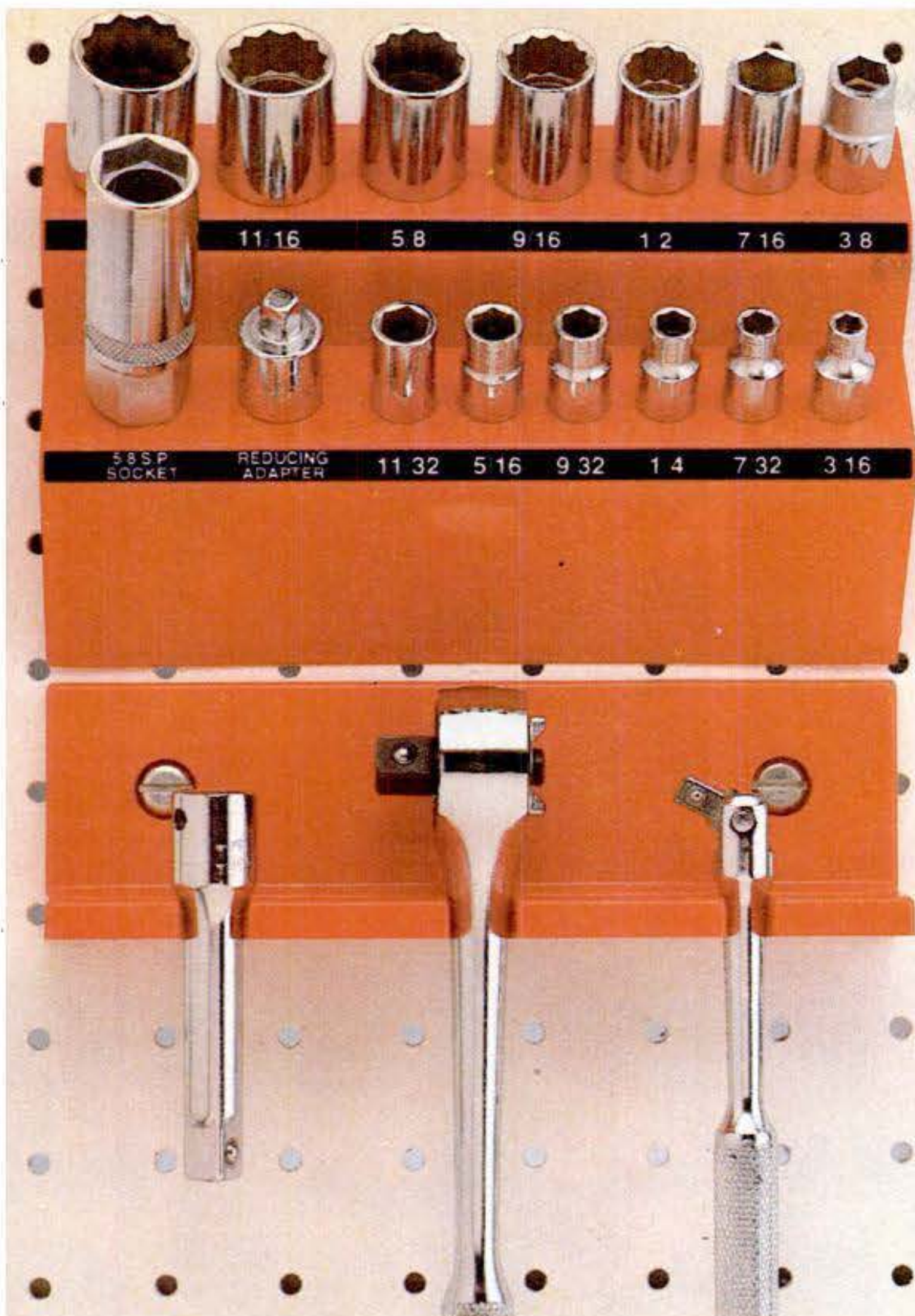
For plans of the Elmer's Dollhouse, please send \$2.00 in check or money order (no cash or stamps) to: Elmer's Dollhouse, P.O. Box 157, Hilliard, OH 43026. Allow up to 6 weeks for delivery.

*As defined by Federal Hazardous Substances Act



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THE RIGHT SOCKET IN AN INSTANT.

Litton's new Shop Organizer ends tool box jumble.

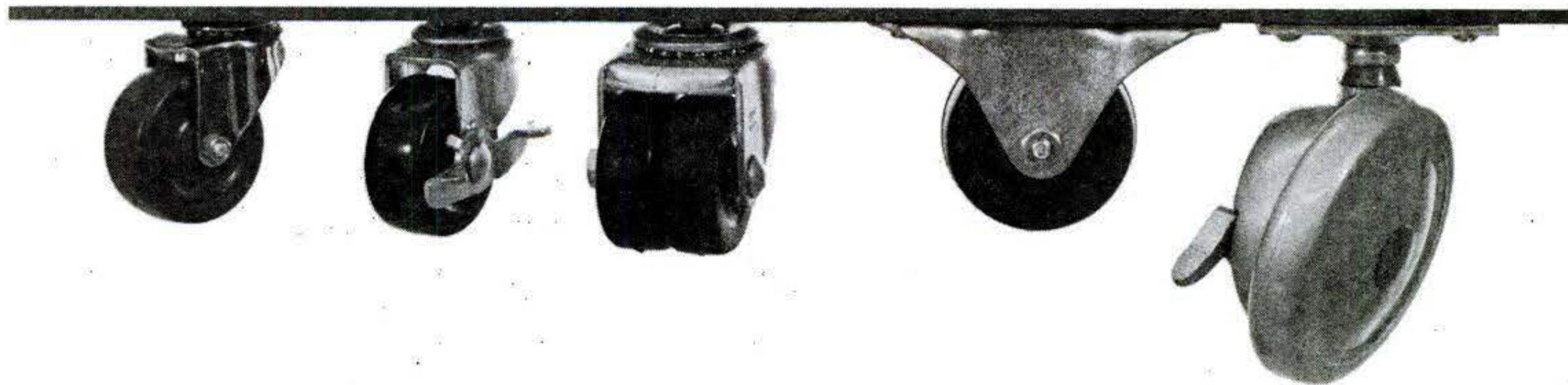
Hangs on any wall. Complete 19-piece 1/4" and 3/8" drive socket set comes with a portable socket tray that lifts off the wall so you can take tools right to the job.

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Litton's new Shop Organizer is made in America. Guaranteed forever. And available wherever quality tools are sold.

NEW SHOP ORGANIZER FROM LITTON.

 **Litton Husky & American Forge**
Changing the way America works.



Industrial/institutional casters are best choice for heavy-duty use around the shop and yard.

From left: plain stem caster; caster with brake; double-wheel caster (also called a piano caster);

rigid (nonswiveling) caster; canted-wheel caster with brake. Brake works with a simple turn.



Mounting plates make stem casters very versatile. From left: socket for recessed mount

through wood brace; for outside corner on metal (inside corner also available); for vertical sur-

face; socket for 1/2-in. pipe or 3/4-in. thin-wall conduit; socket for angle-iron legs.

ing. Operation is quiet, and rolling is easy, even over obstacles.

Buying casters, glides, and wheels

Selections in department stores, hard-

ware stores, and home centers are nothing to get excited about. For example, Shepherd (the big name in ball casters) offers a line in 16 colors and finishes, but only two finishes are likely to be found in stores.

Shepherd also has about 30 mounting styles you can choose from, not just stem or plate. Bassick (the other big name in casters) also has a narrow selection in most

Continued

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When you're in the great outdoors, you never want to get in a position you're powerless to control. And that's where Honda comes in.

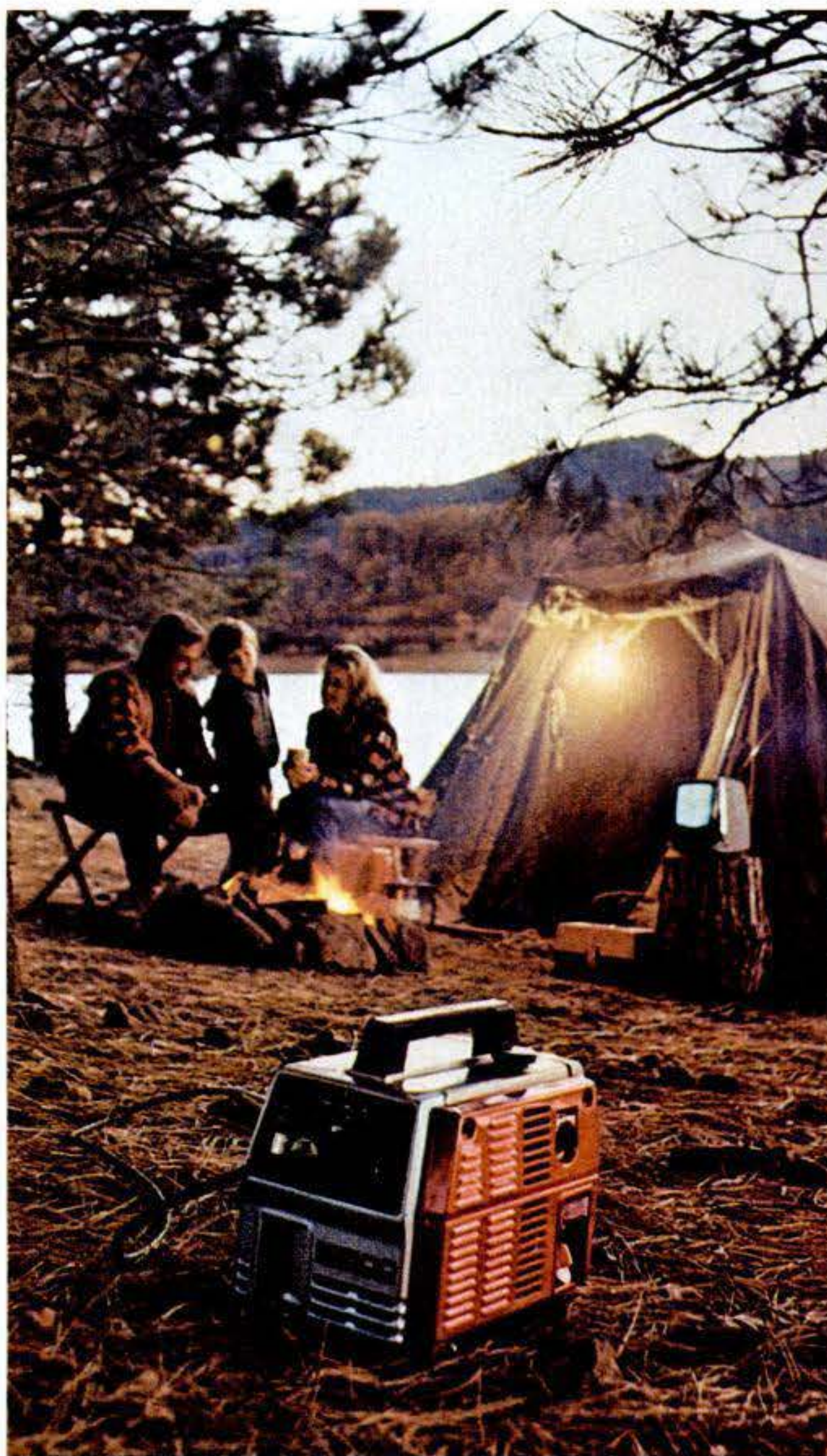
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The new EM-500 portable generator is the ideal companion for campers and hunters. It gives you a maximum 500 watts of power in a lightweight 40 lb. package about the size of a portable TV.

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Before you head out on your next trip, let your nearby Honda dealer tell you about Honda power. Just look in the Yellow Pages or call toll-free 800-648-5311 (Operator 99).

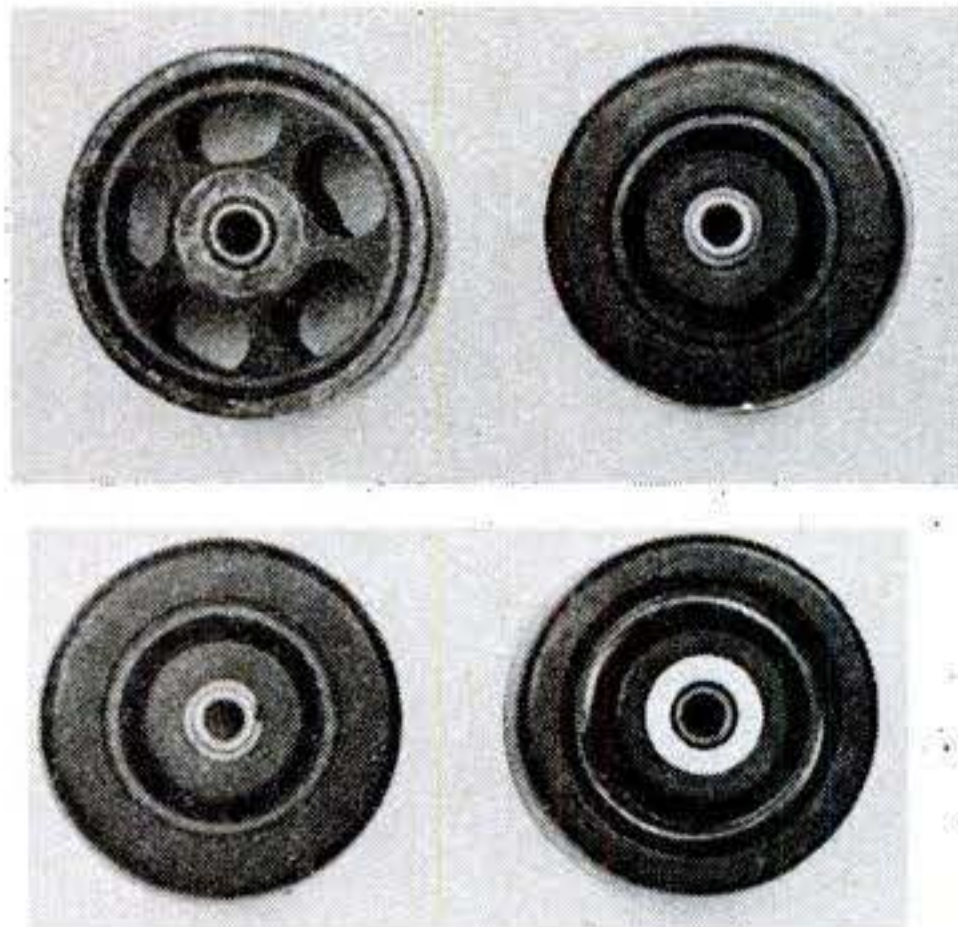
IT'S A HONDA

©1980 American Honda Motor Co., Inc. For optimum performance and safety we recommend that you read the owner's manual before operating the unit.

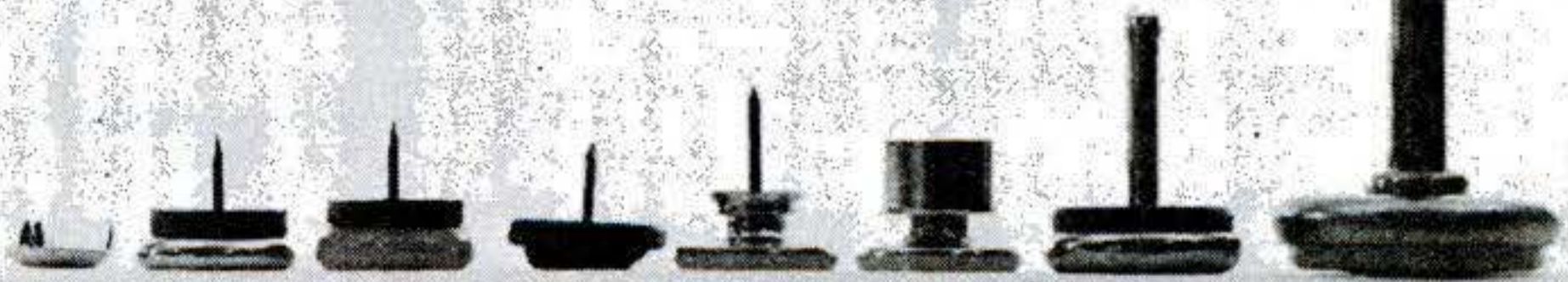


Casters, glides, and wheels

[Continued]



Furniture glides are ideal for use on pieces that are seldom moved. From left: plain steel dome; nickel-steel-base cushion glide; nylon-base cushion glide; carpet-surfaced glide; tilting nylon-base glides with socket for tubular-steel and round wood legs; cushion glide; nylon-base bed glide.



Wheels for industrial casters are made of powdered iron compacted and sintered (top left); soft rubber (top right); hard rubber (bottom left); and canvas-impregnated phenolic resin (bottom right). Replacements can be bought separately; table below gives types and common sizes available (others by special order).

Replacement wheels for shop (industrial) casters

Wheel diameter (in.)	Hub length (approx. in.)	Auto diameter (in.)	Soft rubber—load rating (lbs.)	Price—sleeve bearing (\$)	Price—roller bearing (\$)	Hard rubber—load rating (lbs.)	Price—sleeve bearing (\$)	Price—roller bearing (\$)	Phenolic—load rating (lbs.)	Price—sleeve bearing (\$)	Price—roller bearing (\$)	Pwd. iron and steel—load rating (lbs.)	Price—sleeve bearing (\$)	Price—roller bearing (\$)
1 1/8	1 1/16	7/32				80	1							
1 3/8	1 1/16	7/32	65	1										
2	1	1/4	75	1		90	1							
2	1 1/16	1/4	100	1		125	1					125	1	
2 1/2	1 1/16	1/4	90	1		100	1					175	2	
2 1/2	1 1/16	1/4	120	2		175	2							
3	1 1/16	5/16				125	2							
3	1 1/16	5/16	100	2										
3	1 1/8	5/16	125	3	5	210	3	5	300	9		250	3	6
3	1 1/8	3/8							500	10				
4	1 3/16	5/16	110	3		135	3							
4	1 1/16	5/16	165	4	7	255	4	7	400	9		225	5	
4	1 1/8	3/8	200	5	8	300	5	8				425	5	10
4	2	1/2										1200	14	
5	1 3/16	5/16	125	4		145	4							
5	1 1/16	5/16	190	5	9	280	5							
5	1 1/16	1/2				350	10							
5	2 3/8	1/2	425	8	11	600	8	11	1000	10		1200	10	15

stores. If you don't find what you want, the next step is the Yellow Pages under "casters." Distributors have catalogs, and the selections available are enormous. You can get exactly what you need.

Two recommended distributors: Fred Hill and Son Co., D and Luzerne St., Philadelphia, Pa. 19124 (mainly Bassick); and MacNair Materials Handling Co., Tomlinson and Tracy Rd., Huntington Valley, Pa. (Shepherd and others). Or you can write directly to the manufacturers and ask for industrial caster catalogs as well as the consumer catalogs: Bassick Div., Stewart-Warner Corp., Bridgeport, Conn. 06602; Shepherd Products U.S. Inc., Saint Joseph, Mich. 49085.

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The National Oceanographic & Atmospheric Administration (NOAA) issues detailed and comprehensive weather data for all reporting stations throughout the world—invaluable not only to meteorologists but also to solar and wind-energy researchers. The Department of Energy's output includes technical reports on solar, wind, geothermal, biomass, and fusion energy, and also consumer brochures on energy-effective windows, heat-pump vs. furnace heating, eutectic salts as storage media, alcohol in automobile fuel, and the history of wind power in America.

Where to look

How can you cash in on this vast information reserve? The best starting point is your nearest library. Most medium or large public and college libraries are official U.S. government depositories (there are more than 1200 nationwide); they maintain collections of federal documents for public use which range in size from a few hundred publications to a few hundred thousand. These libraries not only collect federal publications, but also help the public use them. The larger libraries maintain separate government-publications departments staffed by documents specialists, and many of them also offer highly sophisticated computer search services for rapid access to documents.

Besides the depository system, the GPO has bookstores, located in 20 major U.S. cities, that stock currently popular titles and provide assistance in ordering others.

They differ from commercial bookstores in that they stock only U.S. government publications. (GPO bookstores can be found in Atlanta, Birmingham, Boston, Chicago, Cleveland, Columbus, Dallas, Denver, Detroit, Houston, Jacksonville, Kansas City, Los Angeles, Milwaukee, New York, Philadelphia, Pueblo [Colo.], San Francisco, Seattle, and Washington.)

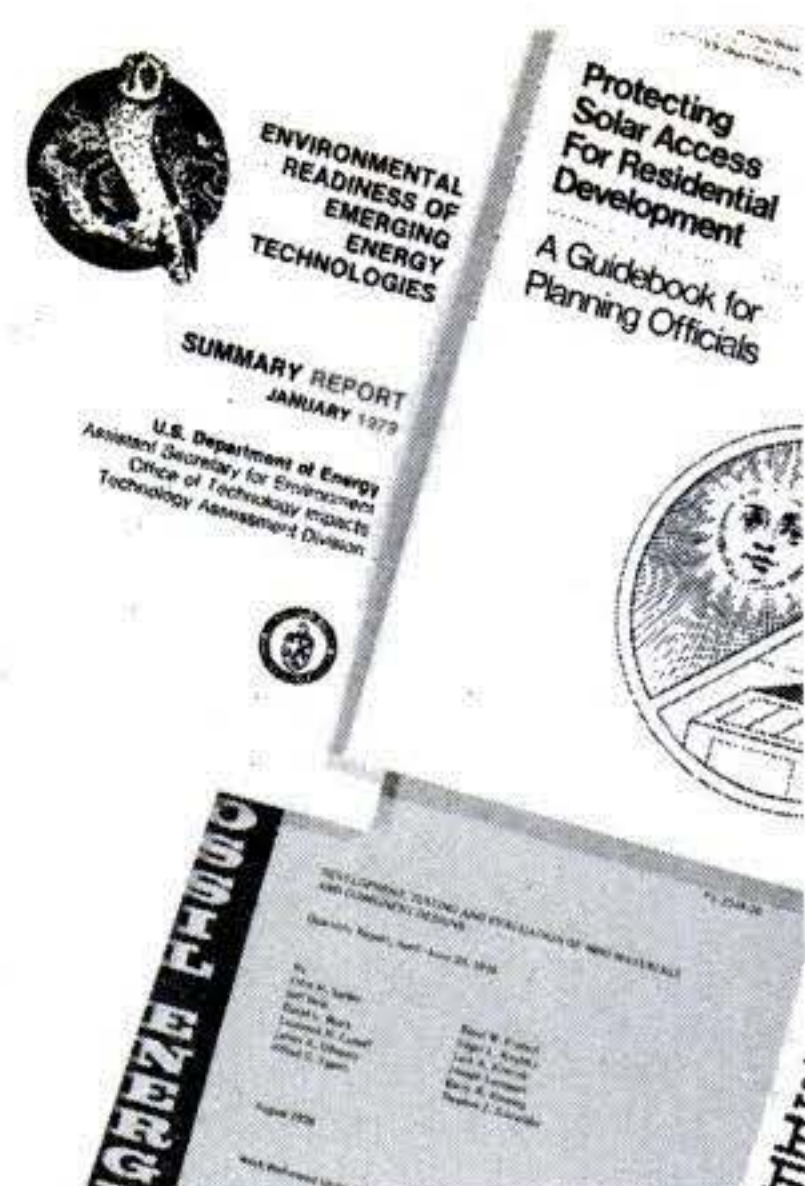
A frequently overlooked source for government documents is your congressional office. If you've been otherwise unsuccessful in getting hold of what you need, a senator or representative may be able to cut through red tape and obtain hard-to-get publications. Write or call either a local or Washington office, and supply as much information as possible, including the title and the agency that issued the publication.

Perhaps the single largest obstacle to the successful use of government publications is, ironically, their overwhelming numbers. Culling from thousands of publications those that pertain to your subject can be a major chore. Fortunately, the government issues several indexes and catalogs (both general and highly specialized) that greatly streamline the search, and the GPO operates a mail-order service that handles as many as 20,000 orders per day.

The basic general catalog, *Monthly Catalog of U.S. Government Publications*, lists 1500-3000 titles each month, indexed by subject, author, and title. It is available at all depository libraries and GPO bookstores. "Selected U.S. Government Publications," issued 10 times each year, lists and briefly describes 150-200 especially popular publications. The *Consumer Information Catalog* is a quarterly list of free or inexpensive consumer-information publications that are available through the Consumer Information Center, Pueblo, Colo. 81009.

Besides these general indexes, hundreds of specialized listings are available. One example is the *Government Reports Index*, which lists the more than 900,000 government-sponsored research, development, and engineering reports available to the public.

So, with a broader knowledge of what the GPO has to offer and how to get it, head on down to your local library or GPO bookstore, and dig in.—Vern Buis





“Betty wouldn’t even set foot on the last lawn tractor we had. But she loves this John Deere.”

Oneal & Betty Humphries, Zion, Illinois

Oneal and Betty Humphries owned two other lawn tractors before they bought a John Deere, and to hear them tell it, “there’s just no comparison.”

“The John Deere is much sturdier,” says Oneal. “Doesn’t bounce you around like the others. Betty likes it so much she does most of the mowing now.”

Oneal Humphries calls it one of the best investments he’s ever made.

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He also has a machine he can use the year round. An optional 4-bushel rear bagger collects grass clippings in summer and leaves in fall. And a snow thrower or front blade takes care of snow removal chores in winter.

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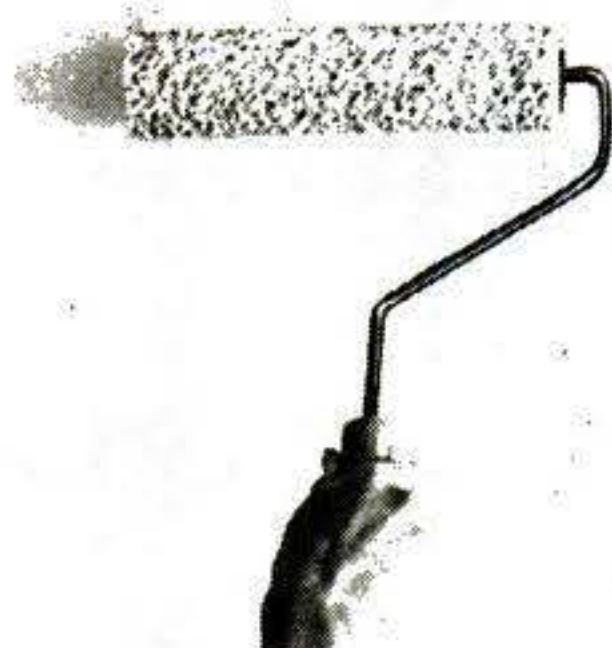
Texture tricks for custom walls

By SUSAN RENNER-SMITH

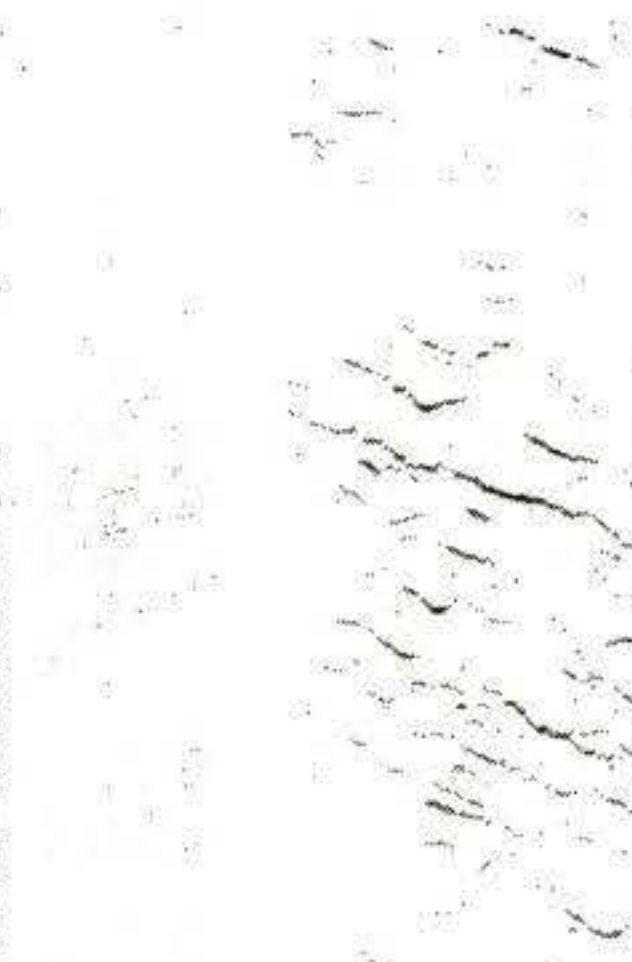
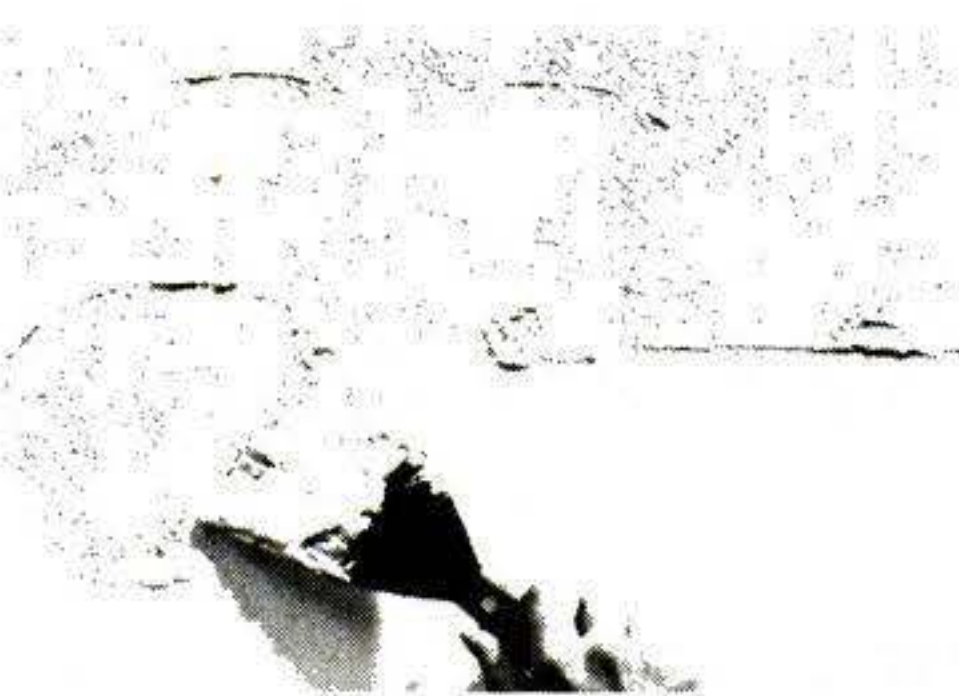
"Dramatic . . . elegant . . . unique," my friends said when they saw the stuccolike accent wall I'd painted in my bedroom. But I'd only been trying to camouflage an ugly wall riddled with 40 years' worth of pits, bumps, and spackled-over cracks.

For all the bonus praise it got, the job was easy. For a subtle stucco effect, I just applied texture paint with a roller. You can also swirl the paint on with a brush or dab it on with a trowel. And you can imprint further texture on the paint with a sponge, corrugated cardboard, or crumpled newspaper. The pictures give some ideas of what's possible. But before slapping the paint on the wall, experiment on an old board till you develop a technique that produces the desired look.

Then, says Fuller-O'Brien—a maker of texture paints in smooth or sand finishes and hundreds of colors—there are just a few simple steps to a successful job. First, fully prepare the wall—cleaning, scraping, spackling, and priming where necessary. Then apply the paint and do your texturing on a wall section no larger than four feet square. While this area is still wet, move to an adjacent section. Apply the paint, blend into the first area, *then* do your texturing. Continue in this way, using a putty knife or small trowel to work the paint into odd corners where your main applicator won't reach. To keep the paint from drying on tools during breaks, wrap the tools tightly in foil or plastic. **P 5**



Rolling on texture paint (above) gives the wall a slightly stippled look. Dragging a corrugated cardboard over the rolled-on paint (top right) transforms its texture. Apply paint directly with a broad putty knife to get a swirl pattern (right).



Textured wall surfaces range from elegant to rustic, depending on the tools used. Subtle swirled panels (top left) were made with paintbrush and straightedge. The classic look (top right) came from gentle diagonal



strokes of putty knife. Crisscrossing the wall with wire brush produced the parquet effect (above left). Traditional stucco look (above) was created by random strokes of a broad knife.

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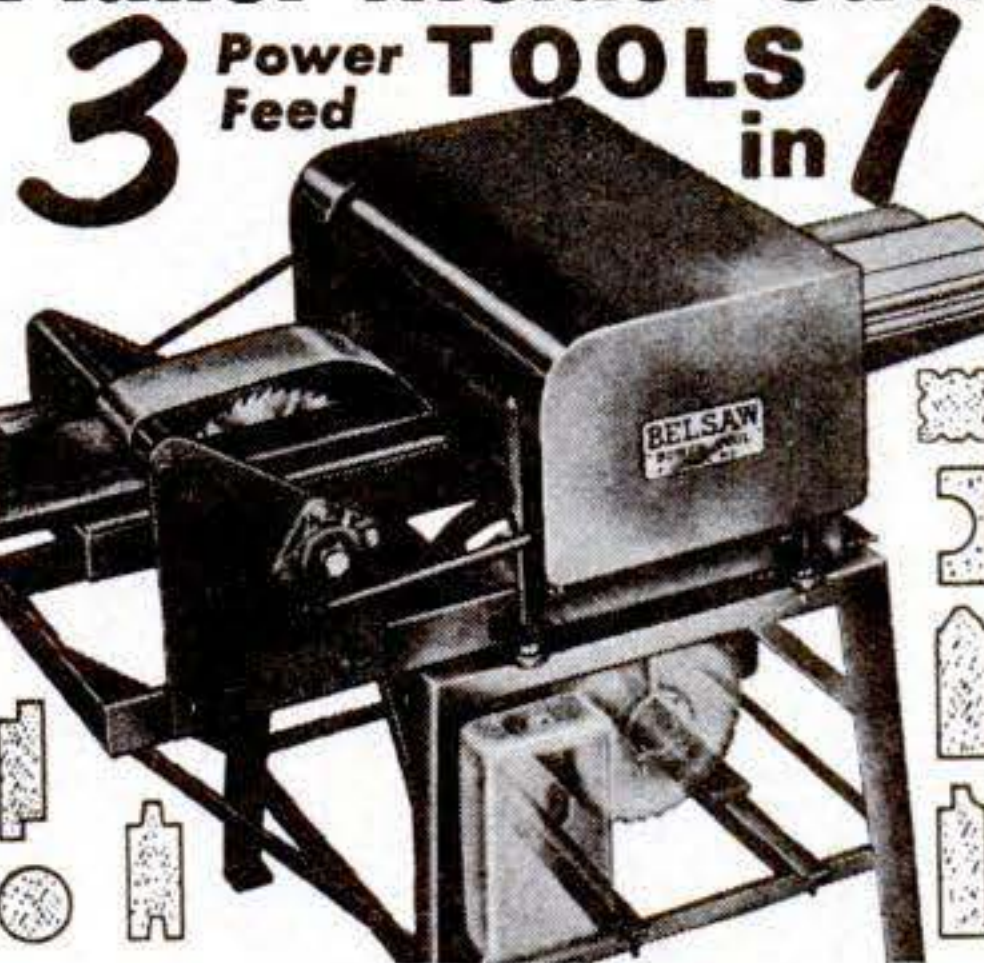
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SPRING
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Safety tips for tin snips

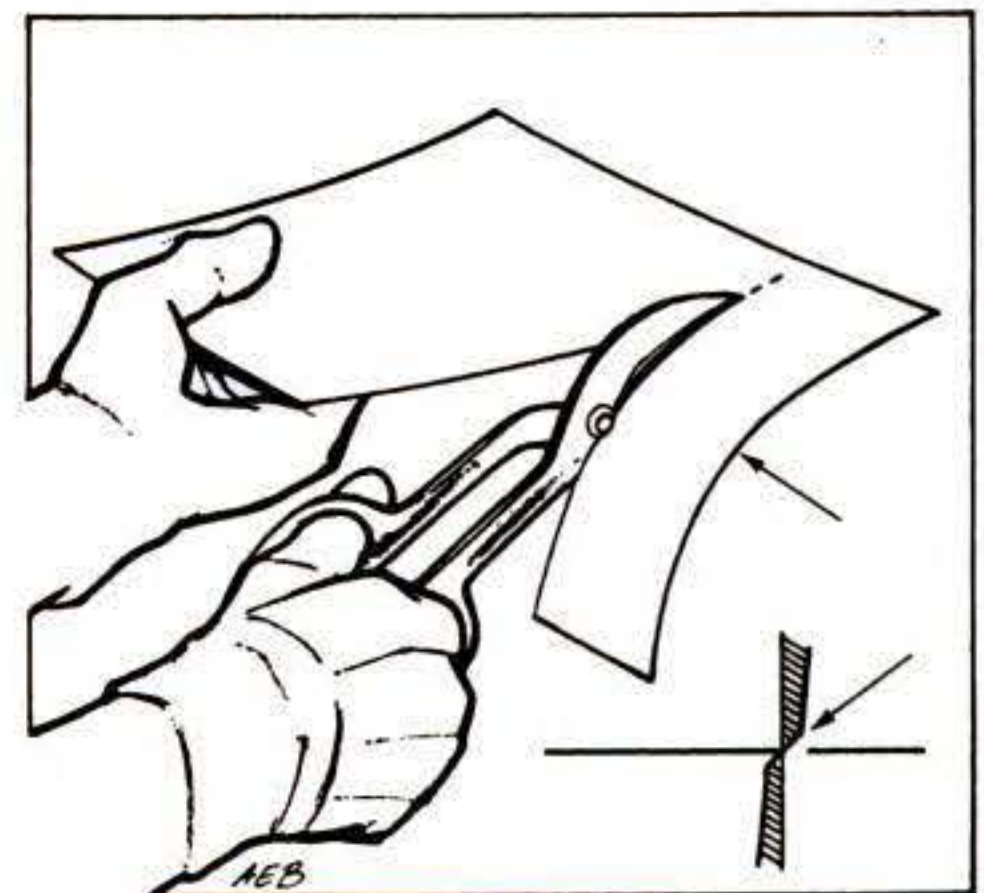
Whether you're an auto mechanic, an industrial worker, or a do-it-yourselfer in your home shop, the first and most important safety rule when using tin snips should also be the most obvious one: Choose the right snips for the job. But before you can make that choice, the Hand Tools Institute (American and Canadian manufacturers of quality hand tools) suggests some basic knowledge of the types of snips available and the jobs each performs.

Tin snips are most commonly used for cutting lightweight sheet metal—usually less than 0.062 inch thick. These snips may also be used for cutting screening, linoleum, canvas, or other hard-to-cut materials of generally light weight. Larger snips used for cutting heavier metals and materials are known as shears.

The most common types of tin snips are: *straight pattern* snips for straight cuts (shown below) or slight curves; *combination*, or *duckbill*, snips for cutting curves in either direction; *compound-leverage* snips (also called *aviation* snips), which require less effort to use due to double-fulcrum, compound-lever action; and *jeweler's*, *curved blade*, and some other types for specialized jobs or for metalworkers.

Once you have chosen the correct snips for the job, the HTI advises:

- Wear safety goggles and gloves.
- Never use snips to cut hardened wire. They may do the job, but you could damage the blade.
- Use tin snips only to cut soft metal. Hardened metal can damage the blade.
- Oil the pivot bolt occasionally to ensure good performance, and make sure that the nut and bolt are properly adjusted.—
Kathleen Murphy Lord



We just called a halt to the horsepower race.

At Chrysler, we don't want to sell you any more outboard than you really need. And the outboard you need may be less than what you think you need.

Remember when the biggest engine you could get was 40 horsepower? And all you needed to win a boat race on that little lake back in Western New York state was a 25 horse motor? Or remember learning to waterski behind a 10 h.p.?

Something happened in outboard-ing since those golden summers years ago. It was the horsepower race. Every year, something bigger, something better. And, needless to say, more expensive. We stopped raising the ante at 140 horsepower. For the majority of single and dual engine

installations, we believe this is more than sufficient.

We recently worked with the manufacturer of a 17' semi-vee hull weighing 1175 pounds. *While it was rated at 115 h.p., the Chrysler 75 moves this hull easily.* It will tow a couple of skiers or carry a whole boatload of fishermen out to where they're biting.

Important to you is the fact that our 75 h.p. costs close to \$500 less than our 115.

With most boat and motor combinations, you reach a point of diminishing returns on the horsepower scale.

We ran our 75 in waterskiing acceleration tests against a Mercury 80. It was an even match, which left us wondering why someone would need 5 extra h.p.

In comparison runs between our 75 and a Mercury 90, the Merc won. It was 2 mph faster at the top end. The question you have to ask yourself is whether a 2 mph difference is worth having to pay for 15 extra horsepower and buying extra gasoline.

The Chrysler Marine line of 19 outboards—from 4 to 140 horse-

power—is hand-built in a small Hartford, Wisconsin plant that's been making outboards since 1944. We believe our range is adequate for most applications. If you must have more power, our stern-drives from 195 to 240 h.p. should suffice.

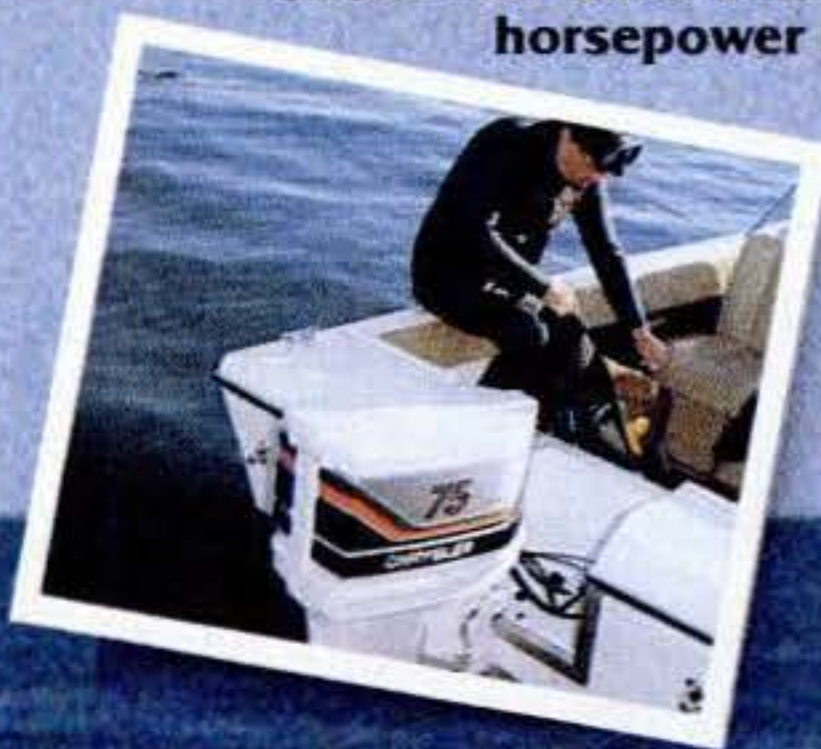
Chrysler outboards are designed and built to be simple.

Take off the engine cowling and you'll see what we mean. No expensive gimmicks to complicate or malfunction. Just good, solid engineering. Engineering that not all our competitors have. Forged crankshafts—not cast. Needle, roller and ball bearings, exclusively, in every power-head. And a CD ignition that is unsurpassed in the industry.

A Chrysler outboard is the perfect mate for today's lighter, more fuel-efficient boats.

Get together with your Chrysler Marine dealer and decide how much horsepower you really do need.

See your Chrysler Marine dealer, soon. And call a halt to the horsepower race.



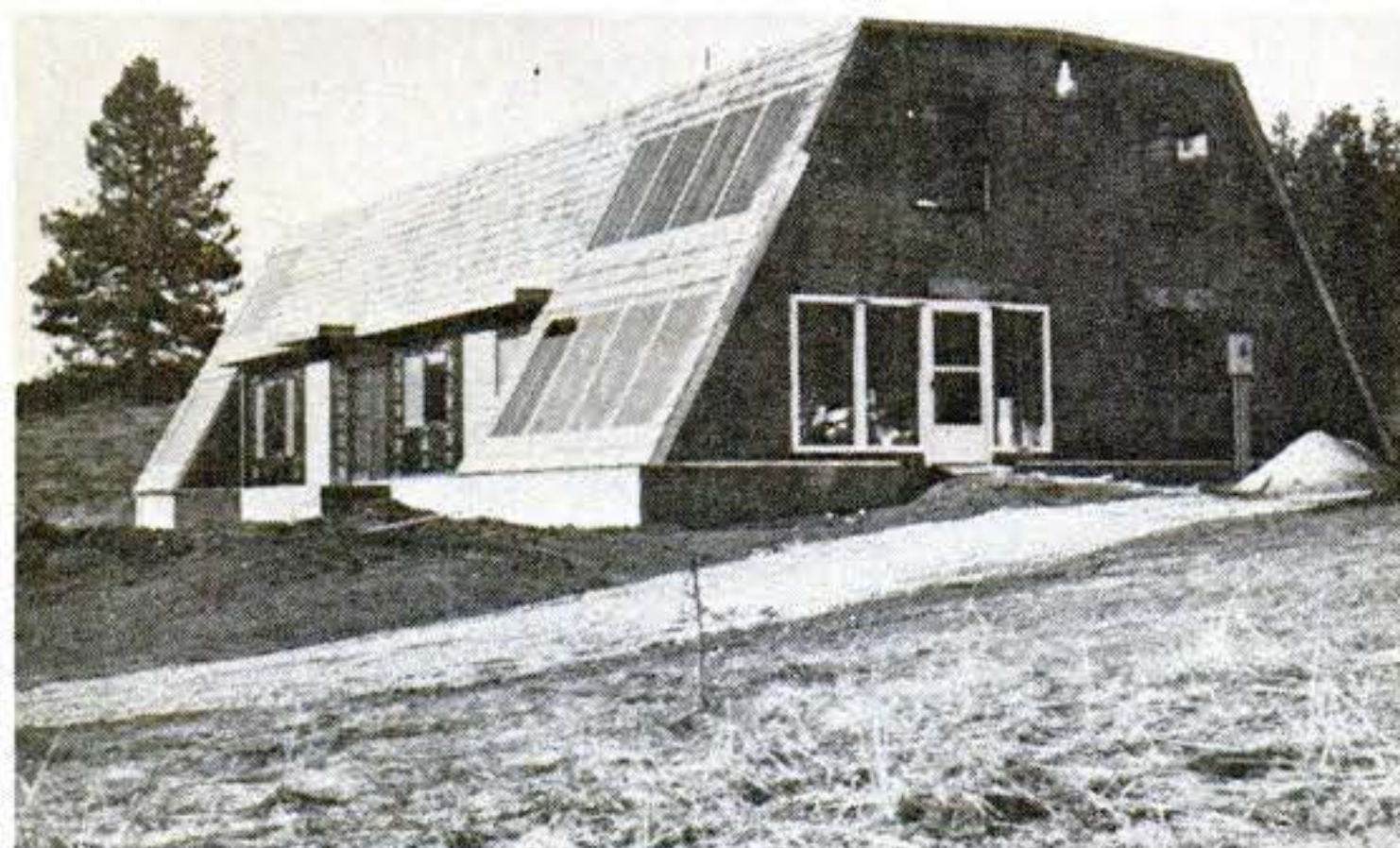
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INBOARDS
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QUALITY ENGINEERED BY THE
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SHOP TALK

By RICHARD STEPLER



Alternate-energy update

Bob Werner's do-it-yourself solar collector was featured as the Nov. '78 Adventure in Alternate Energy ("Wall-Mounted Solar Collector"). Werner reports: "Interest has been tremendous. I've sold over 400 sets of plans at \$4 each and answered questions from about 150 readers. Re-

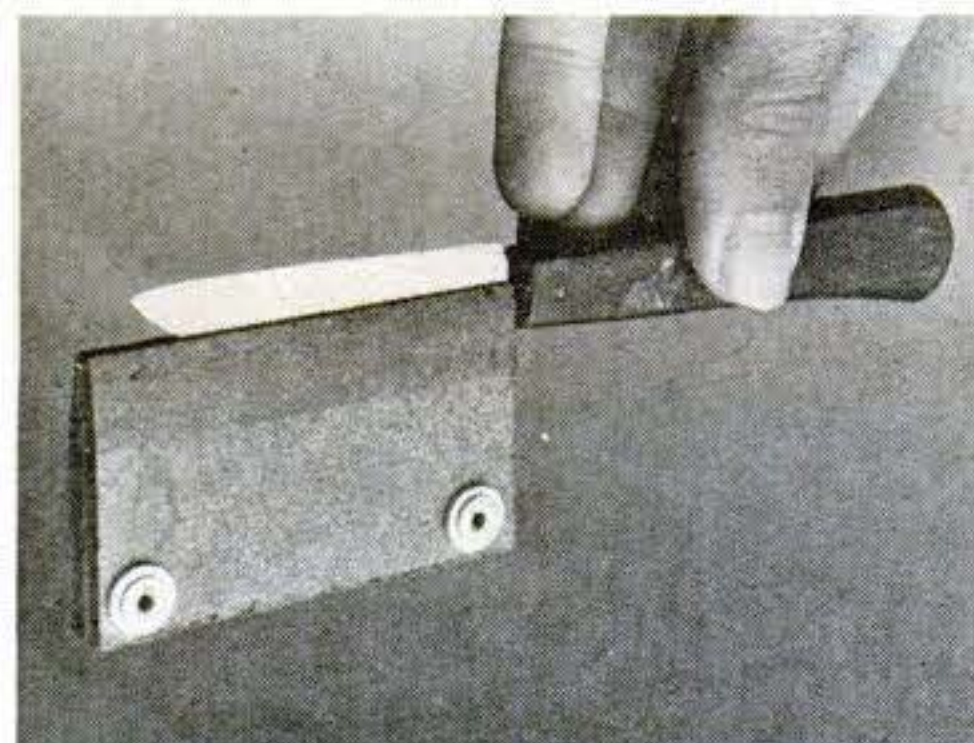
quests are still coming in."

Since the article was published, Werner has moved to Idaho and is building a new home (photo) that uses the same type of solar collector. This time there are more: "Eight units will be used for hot air (space heating), one for domestic water heating, and three for the greenhouse (passive heating)," explains Werner. The collec-

tors are an integral part of the home.

Other features of Werner's new home: R-19 exterior walls framed with 2x6's; R-38 attic insulation; foundation insulated on the outside with one-in.-thick Styrofoam; concrete "span deck" first floor providing 75-ton mass for heat storage.

Werner's new address: Rt. 3, Box 670W, Coeur d'Alene, Ida. 83814.



Sharpening jig

Here's a clever shop tip from PS Consulting Editor A. J. Hand: "The easiest way to strop a tool to a razor edge is on a buffing wheel. Try that with a knife, however, and the wheel is likely to catch the top edge of the blade and snatch the knife from your hands.

"Solution? Pop-Rivet two scraps of 1/8-in. hardboard together as shown in the photograph (dimensions: two inches wide by the length of the blade you're sharpening), and taper the upper edges. Slip the knife blade between the two pieces of hardboard and go to work. This effectively increases the width of the blade so the buffing wheel has no chance of grabbing the upper edge and pulling away the tool."

Package plus

An innovative dispenser from Elmer's is designed to solve many of the problems that have been associated with the fast-setting cyanoacrylate glues; awkward opening (no pin needed with this version); waste of glue and lack of control (it dispenses glue one drop at a time); and clogging (could I tell stories about that!).

Here's how it works: An outer cap (at left in the photo) helps keep glue from evaporating. Bottle with outer cap removed (center) shows tip plug that twists off for use. Bottle at right shows plug inverted and snapped over tip to ensure an airtight enclosure.



Shop extinguisher

Despite our good intentions, we too often allow fire hazards to exist in our home shops. Oily rags, sawdust and wood scraps, paint cans, frayed electrical cords—all offer the potential of a sudden fire. The best way to prevent them is to make periodic inspections. Another good idea is to equip your shop with another tool—a portable fire extinguisher. Kidde recommends a multipurpose Fire Away extinguisher for shops. It contains a tri-



class (ABC) dry chemical—nonconducting and nontoxic monoammonium phosphate—that should put out all fires likely to occur around a workshop.

To use it, says Kidde, you grasp extinguisher firmly, pull the red pin, and, in a crouching position about six feet from the fire, squeeze the handle and aim the stream at the fire's base, spraying in a side-to-side motion.

For a free copy of "How to Choose the Right Extinguisher," write Kidde Belleville Div., 675 Main St., Belleville, N.J. 07109.

A book for owner-builders

Alex Wade, author of *30 Energy Efficient Homes . . . You Can Build* ("Shop Talk," Jan. '78), has another winner: *A Design and Construction Handbook for Energy-Saving Houses* (Emmaus, Pa.: Rodale Press, 1980). Wade, an architect who gets his hands dirty, has compiled a catalog of information for potential homeowner/builders who are dismayed by the high cost of conventional housing, both in terms of initial expense and in energy use, and who are willing to take matters into their own hands.

Part I of this 380-page book details specifics, from choosing a site to materials and tools. Part II takes you through the actual construction of a house, from foundation to roof (Wade's favorite roofing material: galvanized sheet metal).

Part III consists of 11 examples of energy-saving houses. Wade is frank in discussing problems encountered by these owner-builders. Each house is illustrated with photos and floor plans. Part IV gives sources and materials: architects, contractors, tools, efficient appliances, and more. Finally, complete working drawings for one of Wade's homes are included. The book's \$12.95 in paper, \$19.95 in hardcover.

A man in an orange jacket is climbing a rope ladder on the side of a boat. The boat is green and white, and it's moving through blue water with white waves. In the background, there are rocky cliffs under a blue sky with white clouds.

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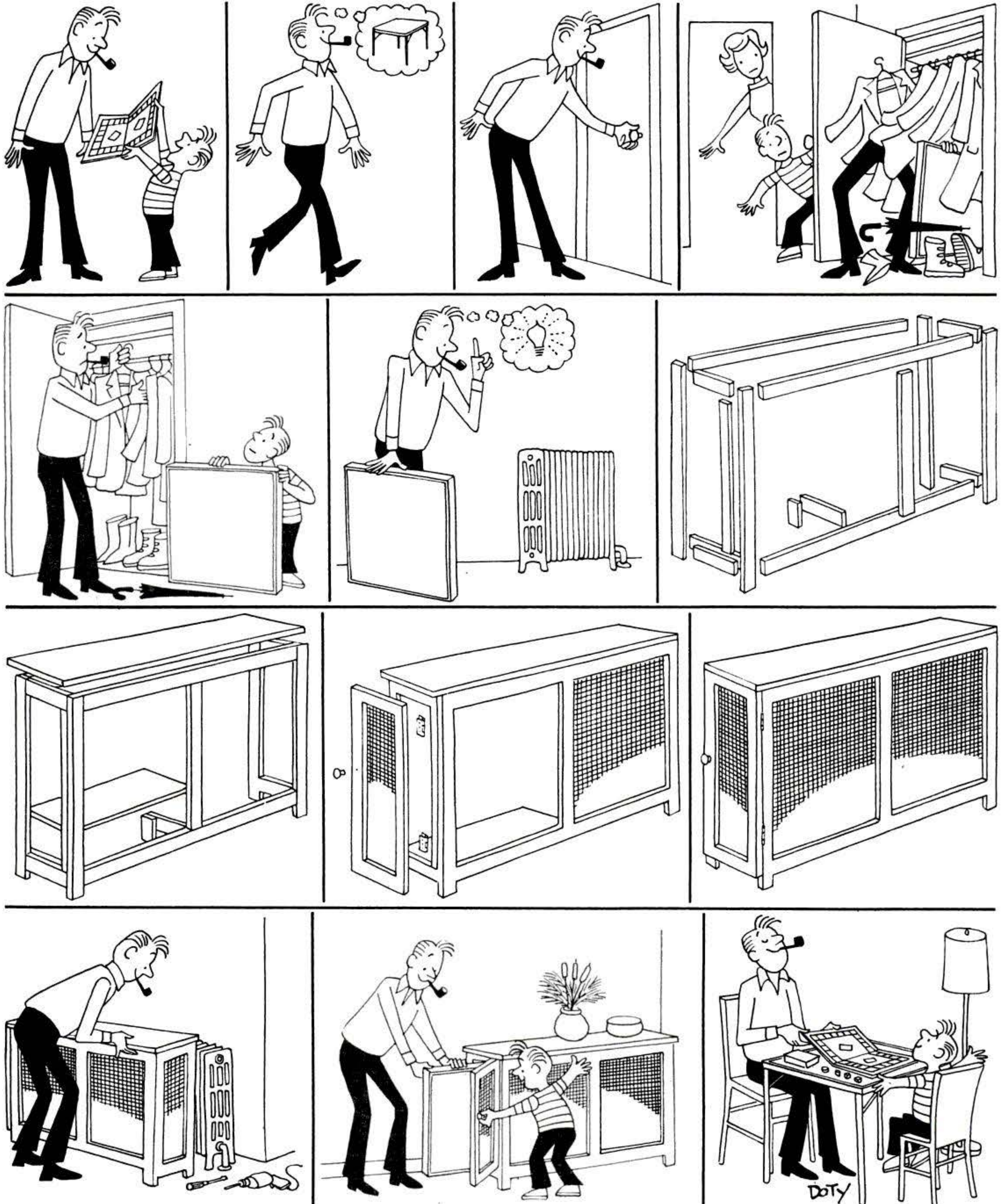
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WORDLESS WORKSHOP

By ROY DOTY

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SNAPPER Hi-Vac riders are for the ultimate in lawn grooming. The vacuum power lifts grass blades into the cutting unit so you get a smooth even cut and bag cuttings even during high moisture conditions. Hi-Vac riders are available with 25, 28 and 33 inch cutting units, and 6, 8, or 11 HP manual or electric start engines.

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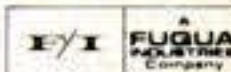


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means you can finish cutting and empty the catcher only once. Without the cover, the Bag-N-Wagon becomes a handy dump cart for hauling garden tools, fertilizer, firewood, etc.

The rear engine SNAPPER Hi-Vac rider gives you a smooth even cut. Plus: Immediate response steering for cutting in tight places; on-the-go adjustment of cutting height and speed; and, a floating cutting unit which minimizes scalping and damage. See your local SNAPPER dealer, the Yellow Pages or write: McDonough Power Equipment

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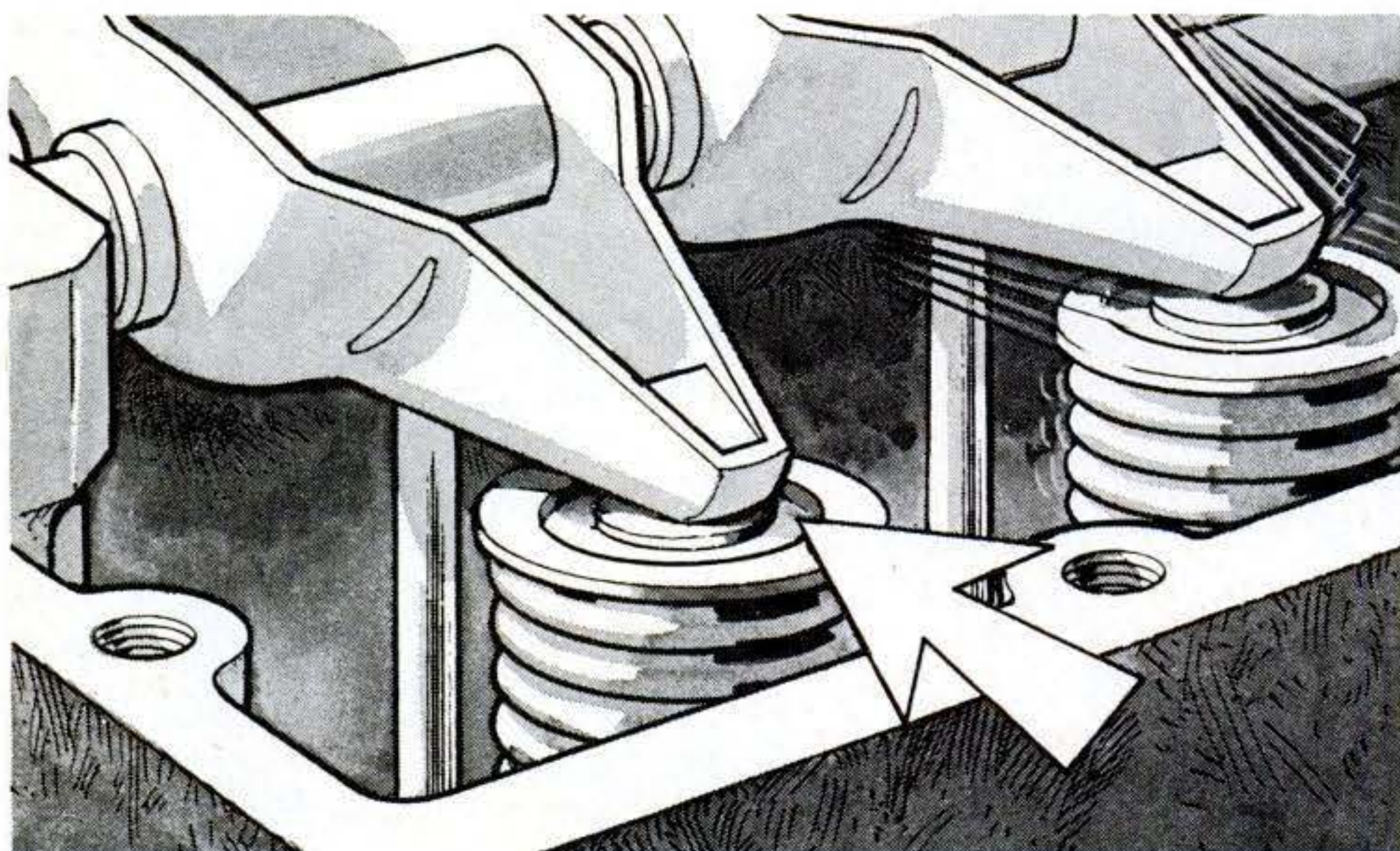


Any way you cut it...it's a snap with SNAPPER!

TAKING CARE OF YOUR CAR

Got a useful car tip? Send it (with Social Security No.) to Car Care, Popular Science, 380 Madison Ave., New York, N.Y. 10017. We'll pay you \$25 if we use it. If two or more readers send in the same usable tip, the one with the earliest postmark will be chosen. Sorry, but tips can't be returned.

By RAY HILL



A quick way to check the camshaft before doing a valve job

If a compression or cylinder-leakage test indicates your engine needs a valve job, you'll need to know the condition of your camshaft. With overhead-cam engines you can see the camshaft. But with most engines, the camshaft is in the engine block, and hard to remove for inspection. An easy way to tell if the camshaft is bad without taking it out is to remove the valve

cover(s), start the engine, and watch the rocker arms. All should move up and down about the same distance. If one doesn't, and the lifter, pushrod, and rocker arm are working, the cam is probably bad. It must be replaced. When you replace a camshaft and bearings, also replace the lifters. Worn lifters rubbing against new cam lobes can ruin them fast.



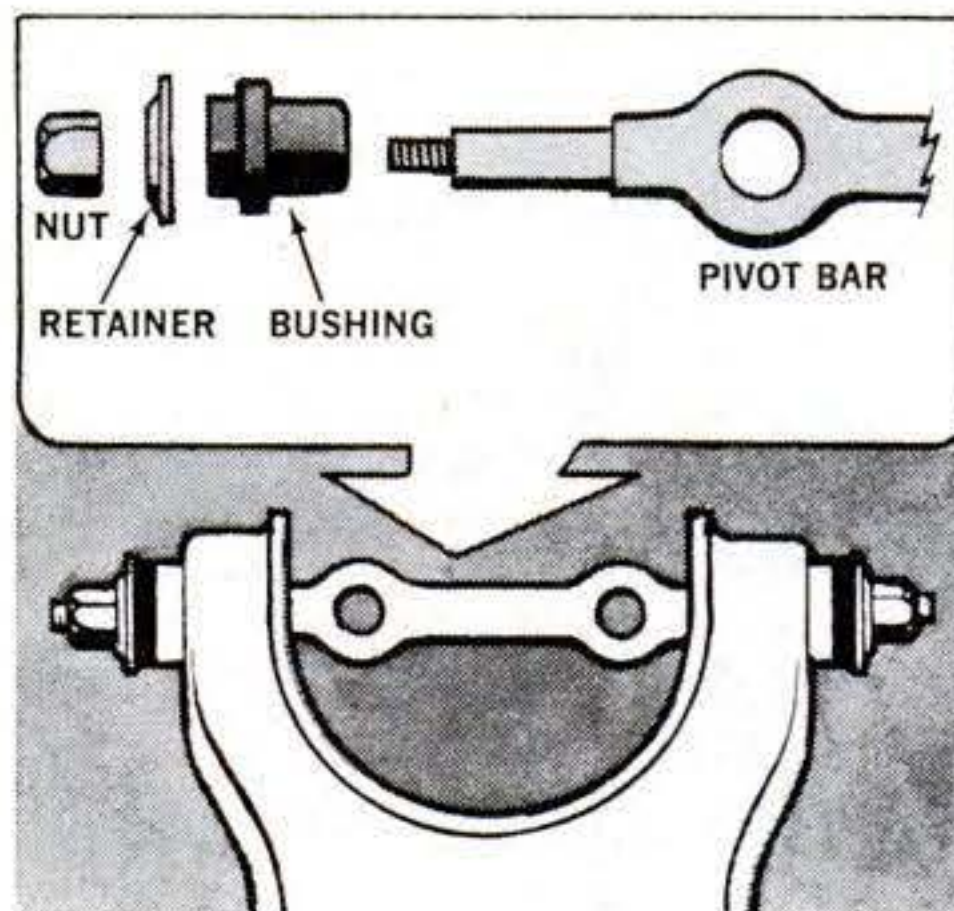
Alternator light stays on

If the alternator light won't go out after the engine is started, the belt is tight, the alternator is charging, and the battery doesn't die, check the fuses. On some cars, if a gauge fuse blows, the alternator warning light will stay on. If replacing a bad fuse makes the light go off after the engine is started, you've got nothing to worry about.



Checking power-brake unit

If you have a "hard" brake pedal—that is, if when you press the pedal it feels as if you're doing a lot of pushing without getting a lot of stopping—here's how to quickly check the power-brake unit. With the engine off, pump the pedal until it's hard. Press your left foot on the brake pedal. Start the engine. When it starts, the pedal should drop some. If it doesn't drop, the unit is bad; replace it. If the pedal does drop, you should check elsewhere (for glazed or contaminated brake pads, for example).



Front-end noise

Trying to track down the cause of front-end noise? Don't overlook the upper and lower control-arm bushings. If any bushing is cracked, broken, or has chunks missing, it must be replaced. Check, too, to make sure that there's a lot of slip between the shaft and the inside diameter of the bushing. If the bushings don't fit the shaft snugly, they must be replaced. Often, the upper control-arm bushings can be inspected from the engine compartment. You'll have to check out the lower bushings from underneath.



Bleeding brakes

When bleeding the brakes on an older car, don't push the pedal all the way to the floor. Have your helper push it about 80 percent of the way to the floor and stop, while you tighten the bleeder screw in preparation for the next stroke. Why? If you push the pedal all the way down, the primary cups in the master cylinder will pass through an area they normally don't touch. If this area has become rough, it may scratch the cups, resulting in internal leakage and premature failure of the master cylinder.



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THANKS, DELCO.



Automotive trouble-shooting quiz

— match wits with the diagnostic champs

By RAY HILL

These questions are based on problems set up to test the skills of student mechanics in state and national Plymouth Trouble-Shooting Contests. Steve Mercaldo, New York automotive-mechanics instructor, whose students have been highly successful in past contests, assisted in the preparation of the problems in this quiz.

Questions

1 Right turn signals don't work

Your car's left turn signals work fine. But the front and rear signals on the right side are dead—they neither light nor flash.

Your right rear taillight lights when the headlight switch is on. When the headlight switch is turned to the parking-light position, the right front parking light works okay, as well.

Both rear stoplights light when the brakes are applied.

Turning on the hazard-warning lights results in flashing at all four bulbs—indicating that nothing is wrong here, either.

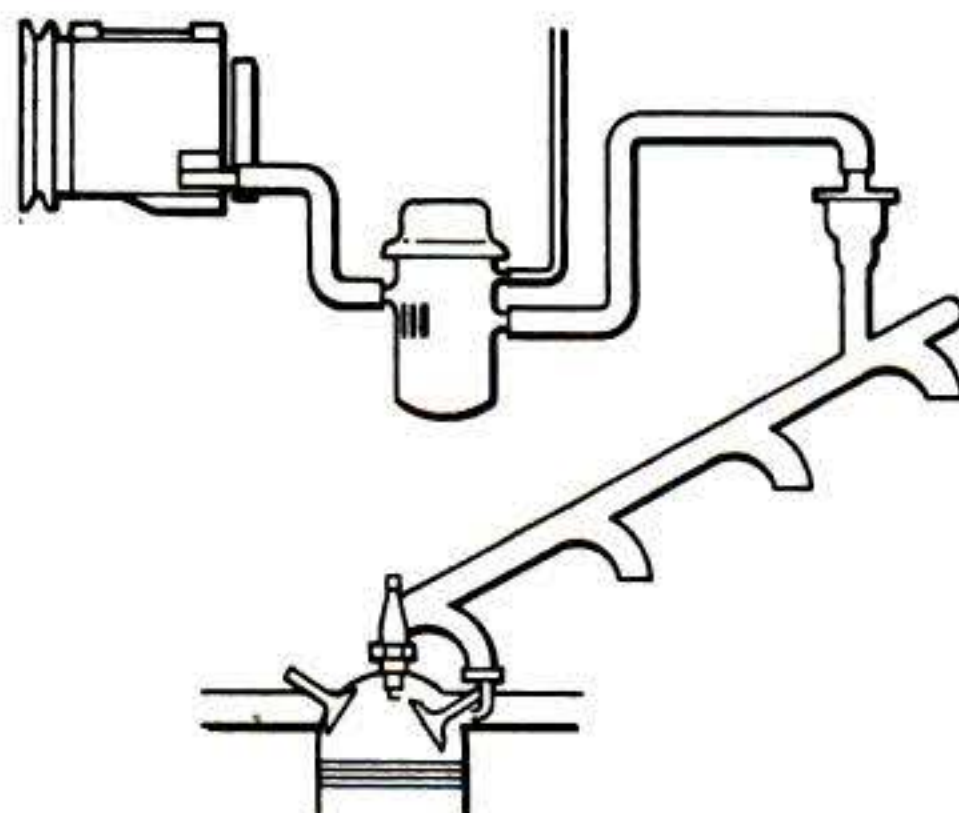
The wires for the right-side directionals seem to be in good shape. There are no breaks in the insulation, no corrosion, and they're connected tightly.

Wiggling the directional signal selector lever does not make the right-side signals work.

You install a new flasher. But that doesn't help.

What's keeping the right turn signals from working?

2 Engine backfires during deceleration



Your engine is tuned to specs. Ignition timing, plugs, and other related items are fine.

A check with an infrared tester indicates carburetor mixture is correct. Manifold vacuum is a steady 21 inches at idle.

All vacuum hoses are routed correctly and tightly connected. There are no vacuum leaks. There are no leaks in the exhaust system.

Your engine has an AIR system like the one shown above. You remove the air supply where it connects at the exhaust manifold. You have a friend start the engine while you suspend your hand over the end of the hose.

A healthy supply of air is coming out the end of the hose at idle. You have your friend accelerate to high rpm. There's still plenty of air coming out.

You tell your friend to decelerate. Air flow does not decrease during deceleration. You reconnect the hose.

Next, with the engine idling, you remove the vacuum hose that goes to the diverter valve and put your finger over the end of the hose. You feel plenty of vacuum.

You reconnect the hose and have your friend accelerate and then let off the gas. The backfiring still occurs when the throttle is released.

You shut off the engine, remove the belt that drives the AIR pump, then restart the engine.

Again your friend accelerates and decelerates. But this time there is no backfiring during deceleration.

Now you know what's causing the problem. What is it?

3 Engine runs rough at idle and low speed

Your engine is equipped with the venturi-actuated EGR system shown in the accompanying drawing.

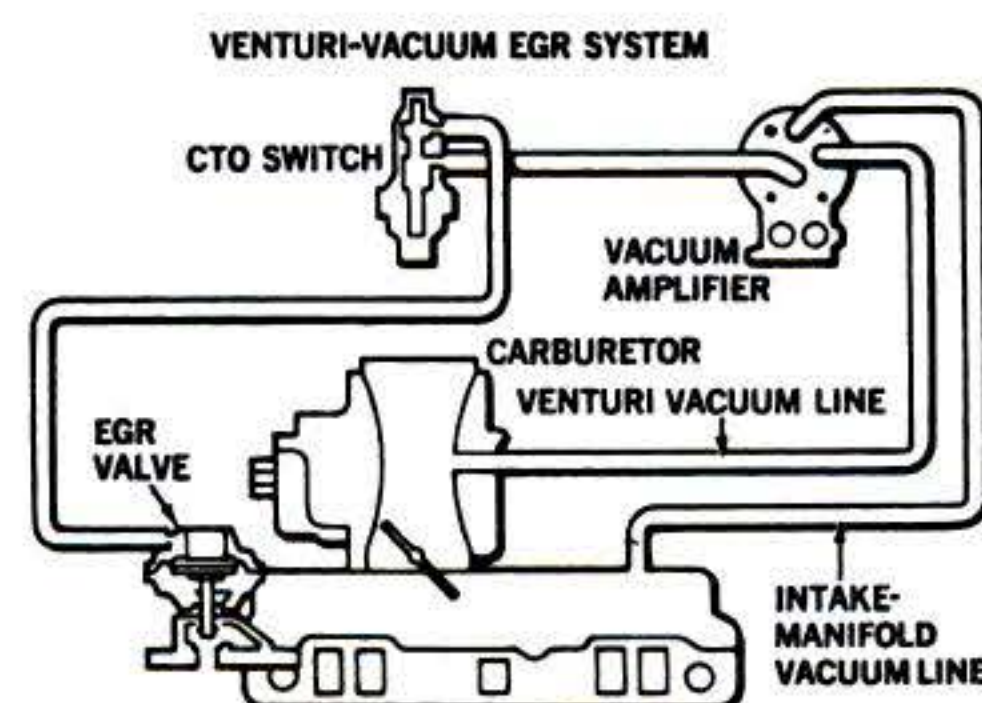
At turnpike speeds, engine performance is fine. But around town, at low speeds or when you stop for a light, the engine runs very rough.

Compression checks out okay. And when a spark-plug wire is held $\frac{1}{4}$ inch from a good ground and the engine is cranked, there's a good, steady spark.

The distributor cap is not cracked. There are no signs of carbon tracking. The towers are clean and uncorroded.

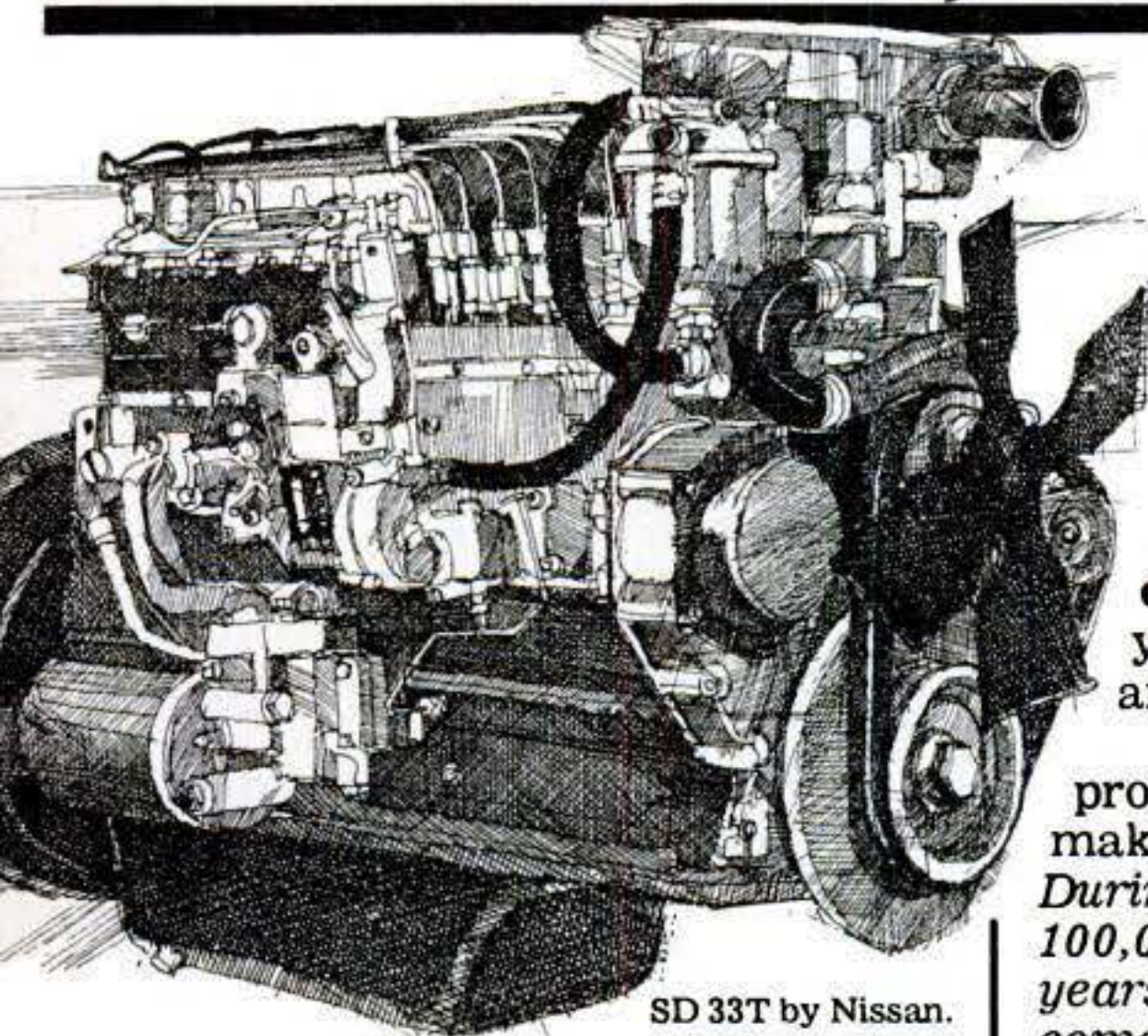
Spark-plug wires check out okay

Continued



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Automotive quiz

[Continued]

with an ohmmeter, and a visual inspection finds no cracks. At night with the engine idling and the hood raised, you can see no sparks jumping anywhere.

Attaching a vacuum gauge to the intake manifold while the engine idles reveals a vacuum reading that fluctuates between 11 and 15 inches.

A power-balance test reveals some weak cylinders (the rpm doesn't drop as much in these cylinders when the spark plug stops firing).

A visual check of the camshaft and valve-train operation doesn't reveal any problems.

When the vacuum line to the EGR valve is disconnected and plugged at idle, the engine runs fine.

What's wrong?

4 Cold engine runs poorly

When you start your car in the morning, black smoke comes out the tailpipe and the engine runs rough. But as it warms up, engine performance improves. After a few minutes, it runs fine.

You immediately suspect a choke malfunction. But the choke is adjusted to specs. The fast-idle mechanism is also adjusted to specs.

You remove the top of the air cleaner and watch the choke plate when the cold engine is started. The choke plate opens completely when the engine is warmed up. It does not stick or bind.

The choke kickoff does not move the choke shaft and choke plate when the engine is started. A check with a vacuum gauge indicates good vacuum to the choke kickoff at idle. The kickoff linkage is connected and adjusted properly.

The air filter is new, so you know the car is getting enough air.

The PCV valve checks out okay. Removing the valve from the valve cover and plugging it with your finger while the engine is idling results in an rpm drop.

The engine breather filter is also new, so that's not the problem.

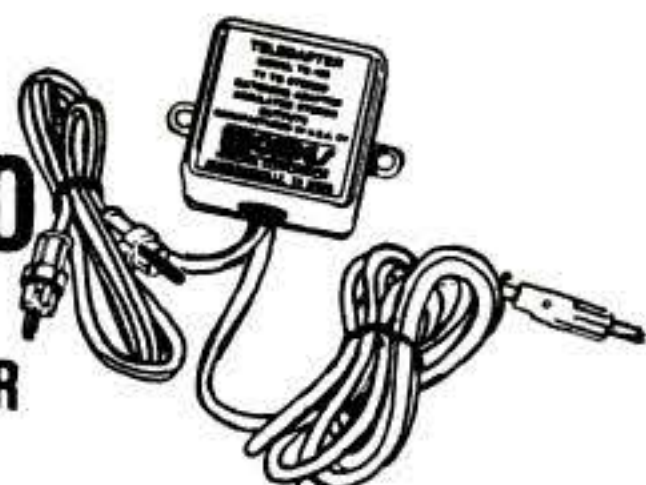
Installing a set of spark plugs with a higher heat range does not improve cold-run performance. You drive over to your local garage and have the engine (at operating temperature) checked with an infrared analyzer. The fuel mixture is not running rich.

An oscilloscope check of the ignition system indicates a good steady spark.

What's causing the problem?

Continued

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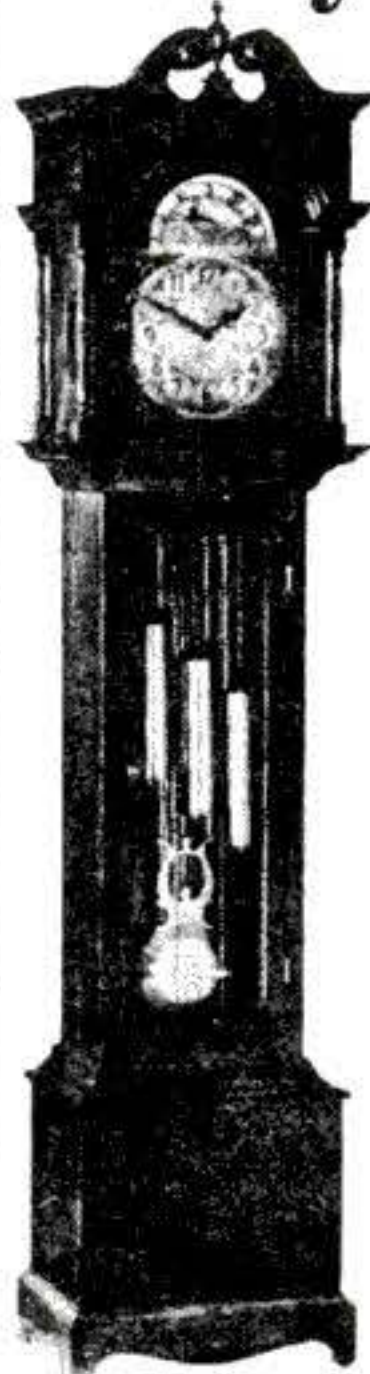
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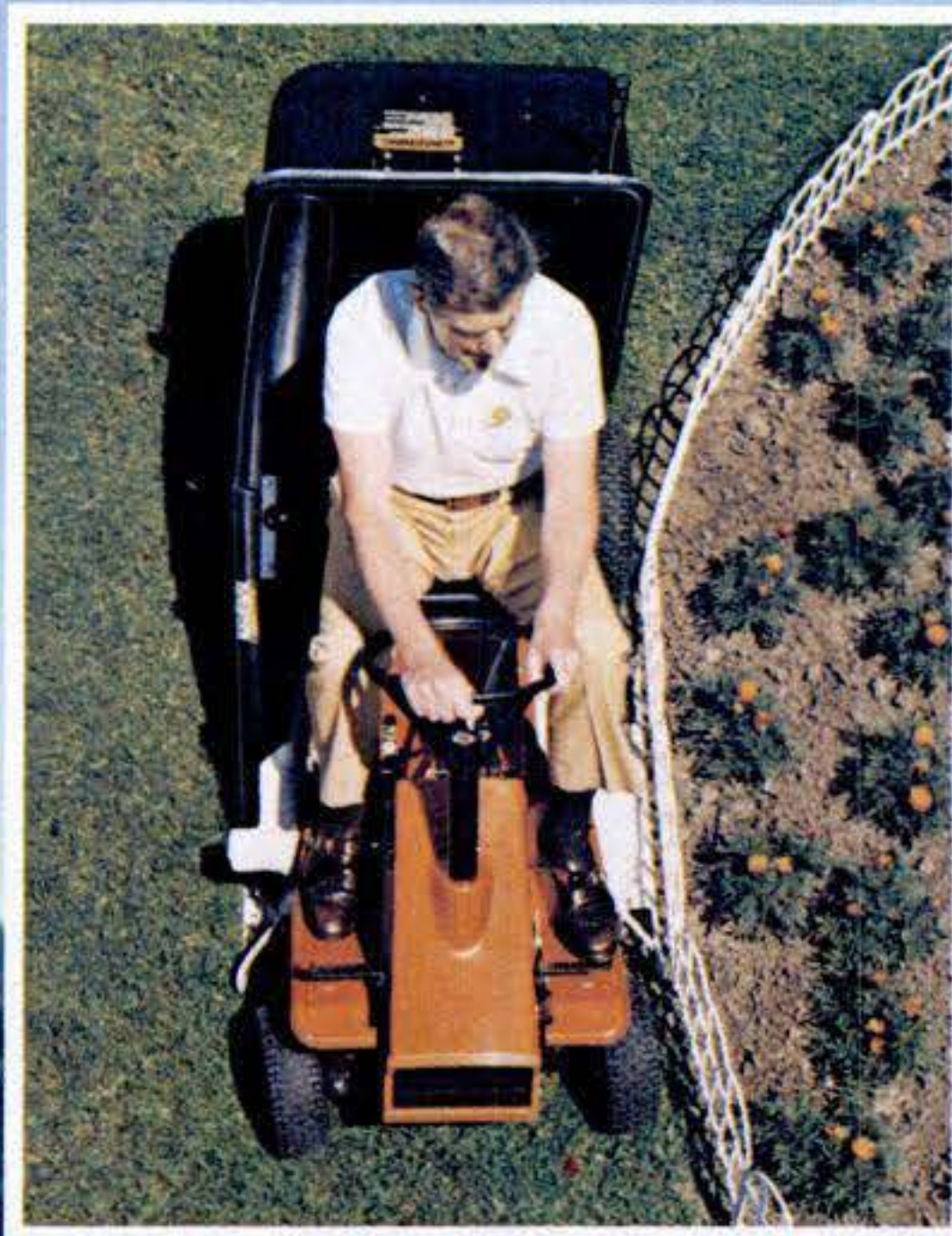
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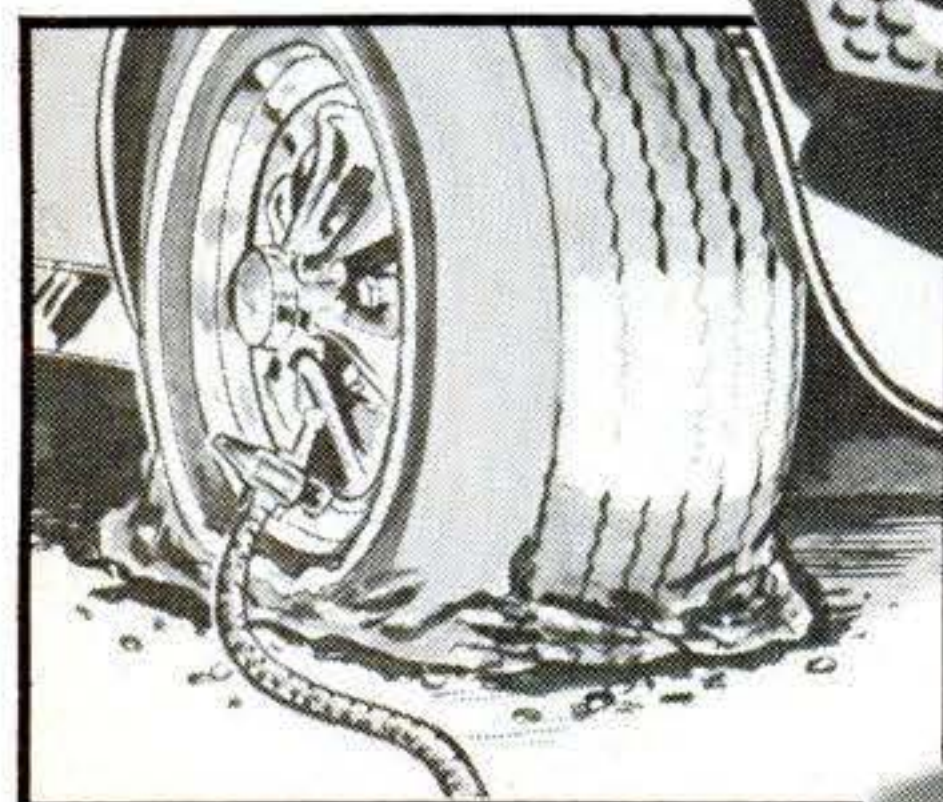
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Automotive quiz

[Continued]

5 Engine uses oil

Lately it seems your engine has been using oil almost as fast as it uses gas. Anytime the engine is started after it has not been run for a few hours, blue smoke comes out the tailpipe. After a while the smoke disappears and the exhaust is clean again.

A compression check shows compression to be within specs.

With the engine idling, manifold vacuum is a steady 20 inches on the vacuum gauge.

A check of the spark plugs shows an excessive amount of carbon.

A cylinder-leakage test reveals no problems. All of the cylinders have a nearly identical leakdown rate (well under 20 percent).

What's causing the engine to use so much excess oil?

6 Brake pedal fades toward floor when brakes are used

Your car has disc brakes up front and drums in the rear. Whenever you press on the brake pedal, it keeps traveling toward the floor after you feel the initial resistance. The car still stops, but not as quickly as before.

An inspection of the front disc-brake rotors reveals that they measure to specs and do not exhibit excessive runout. Wheel bearings are adjusted correctly; brake pads are good. The calipers aren't leaking or frozen; front brake hardware is good.

A checkout of the rear brakes shows that the drums measure to specs and are not cracked, scored, or out of round. Wheel cylinders aren't leaking or frozen, and all the brake hardware is in good shape here, too.

You look at the master cylinder and find no signs of external leakage. When you remove the top of the master cylinder, you find that both reservoirs are full of brake fluid.

All the hydraulic lines attached to the master cylinder are good. There are no cracks or external leakage visible anywhere in the brake system.

Perhaps there's air in the fluid somewhere. You bleed the brakes, but that doesn't help.

What's wrong with your brakes?

Answers

1 A defective directional-signal switch is the culprit.

You wasted your money on that new flasher. Both sides use the same one. The left signals work, so the old flasher has to be good.

Each of the four signal bulbs has two filaments. In back, one filament is for taillights. The other is used for turn signals, brakes, and hazard lights. Up front, one filament is for the parking lights, the other for turn signals and hazard lights.

Although hazard-warning lights use a different flasher, they use the same circuitry from the signal switch as do the turn signals. Since all four warning lights work, the circuitry from the switch is okay. Your troubleshooting has eliminated everything that could cause the problem except the switch.

2 The diverter valve in the AIR system is bad. It must be replaced. The tip-off was when the engine decelerated and there was still a steady supply from the air hose going to the manifold check valve.

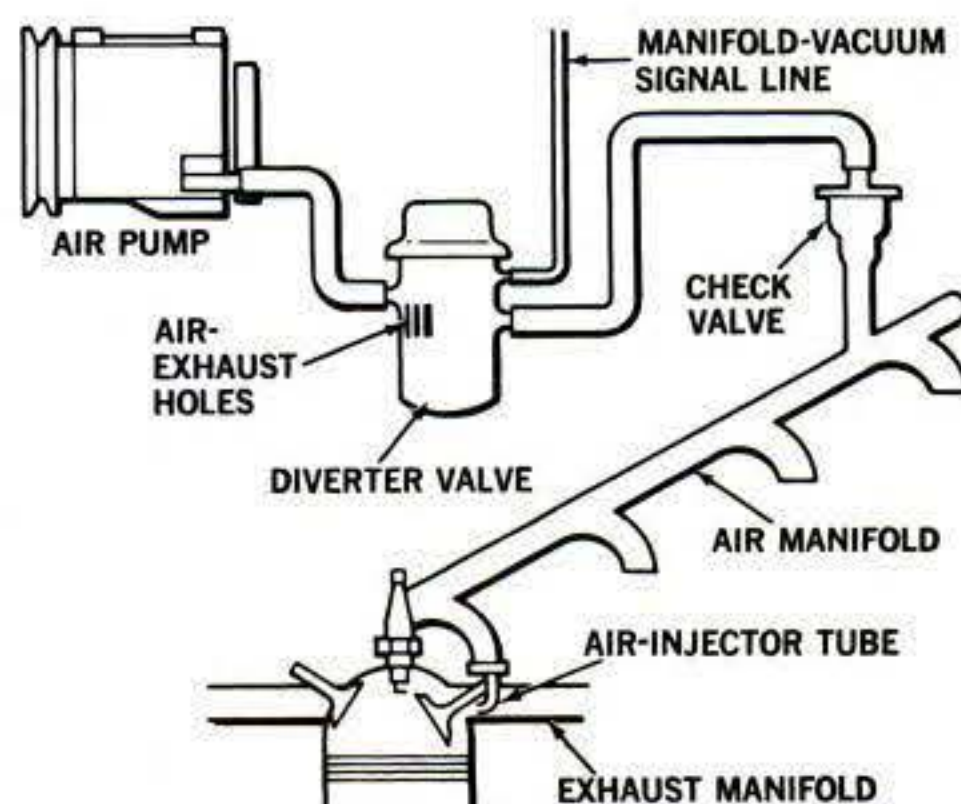
The AIR (Air Injection Reaction) system is used to promote further burning of unburned gas in the exhaust manifold, thereby reducing emissions. Three things are necessary for combustion—fuel, heat, and oxygen. There's already plenty of heat in the exhaust manifold. So if air is added, most of the unburned fuel present will burn. The AIR system provides that air.

An AIR system consists of the AIR pump, a diverter valve, and a check valve—plus the plumbing necessary to connect everything.

The AIR pump is driven by a belt from the engine's damper pulley. Whenever the engine is running, the AIR pump is pumping air. When everything is working right, air is forced into the exhaust manifold at all times except during deceleration.

When you decelerate, the amount of unburned fuel in the exhaust becomes higher. If the air is introduced *then*, you'll get excessive combustion,

Continued



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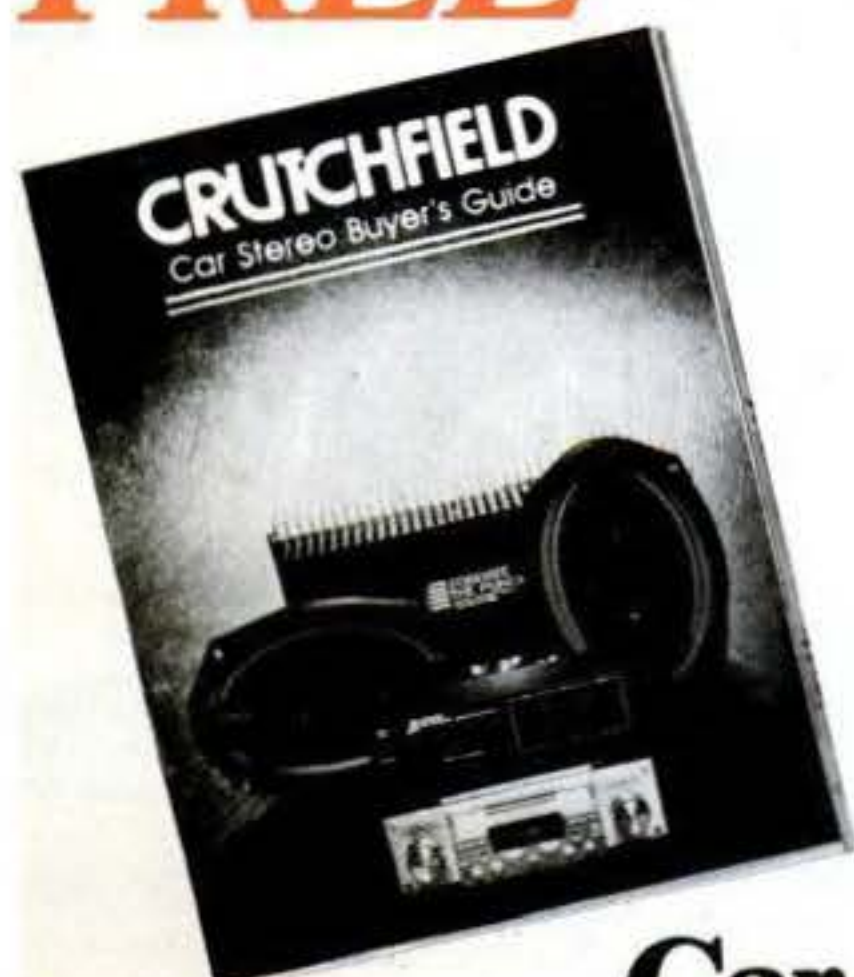
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Automotive quiz

[Continued]

which manifests itself as a popping or backfiring sound.

At idle or cruise speeds, air from the AIR pump passes through the diverter valve, through the check valve, and into the exhaust manifold. During deceleration, manifold vacuum increases, so the vacuum to the diverter valve causes the valve to shut off air flow to the exhaust manifold. The air from the AIR pump exits through the air exhaust holes.

The check valve is basically a spring-loaded, one-way valve. It permits air flow into the exhaust manifold. But it does not—in the case of a backfire, for example—let the exhaust gases travel back through the AIR plumbing where they could damage the pump.

The giveaway here was when you disconnected the air hose at the manifold check valve and felt air coming out of it during deceleration. There should be no air coming out at that time.

There was plenty of vacuum to the diverter valve during deceleration; you know that because you removed the vacuum signal hose to check it. So the diverter valve is not doing its job.

An additional clincher was removing the drive belt to the AIR pump—which quickly cured the problem.

3 A bad vacuum amplifier is the problem. It must be replaced.

The tip-off was when you disconnected and plugged the vacuum line to the EGR valve and the car ran fine. Obviously the EGR valve was getting vacuum at idle—and it shouldn't.

The vacuum amplifier's job is to let the manifold vacuum reach the EGR valve during cruise speeds. The vacuum opens the EGR valve, letting some exhaust gas into the intake manifold, where it is drawn into the combustion chambers along with the air/fuel mixture. The exhaust gas present in the combustion chamber reduces combustion temperatures, thereby reducing NO_x emissions.

The amplifier knows when it should allow manifold vacuum to pass through to the EGR valve by the vacuum signal it receives from the vacuum line running from the carburetor venturi. When the throttle is closed, or almost closed, as it is at idle and low speeds, air flow through the venturi is reduced, so no vacuum is created in the venturi vacuum line. As the throttle is opened wider (at higher speeds), air blown through the venturi in-

Continued

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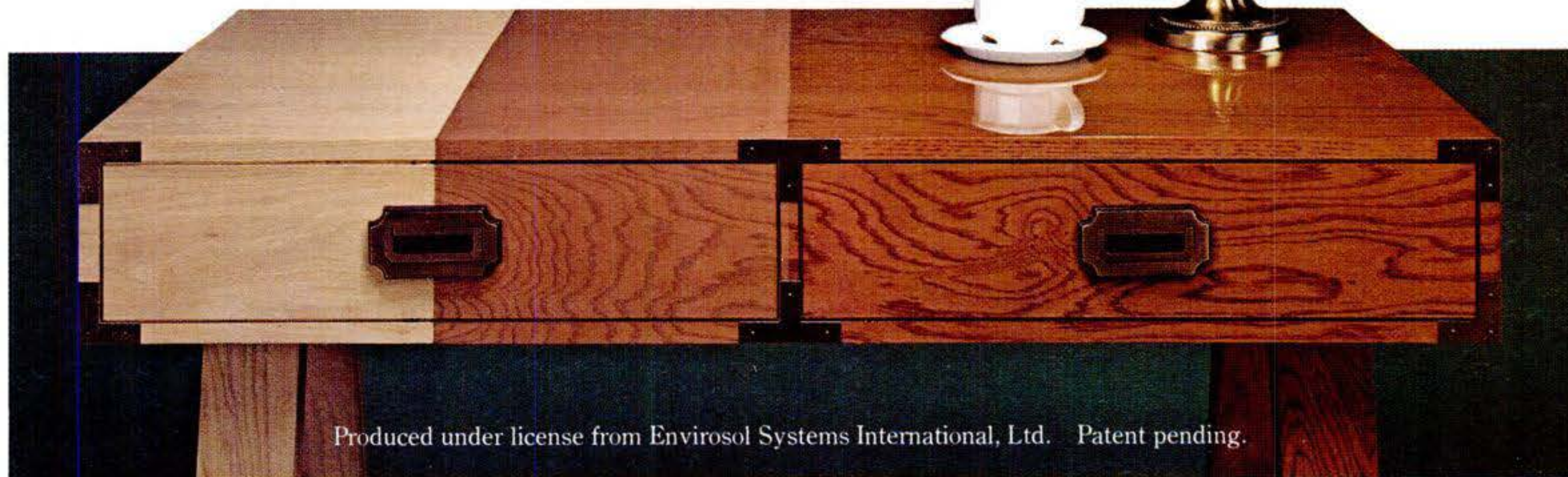
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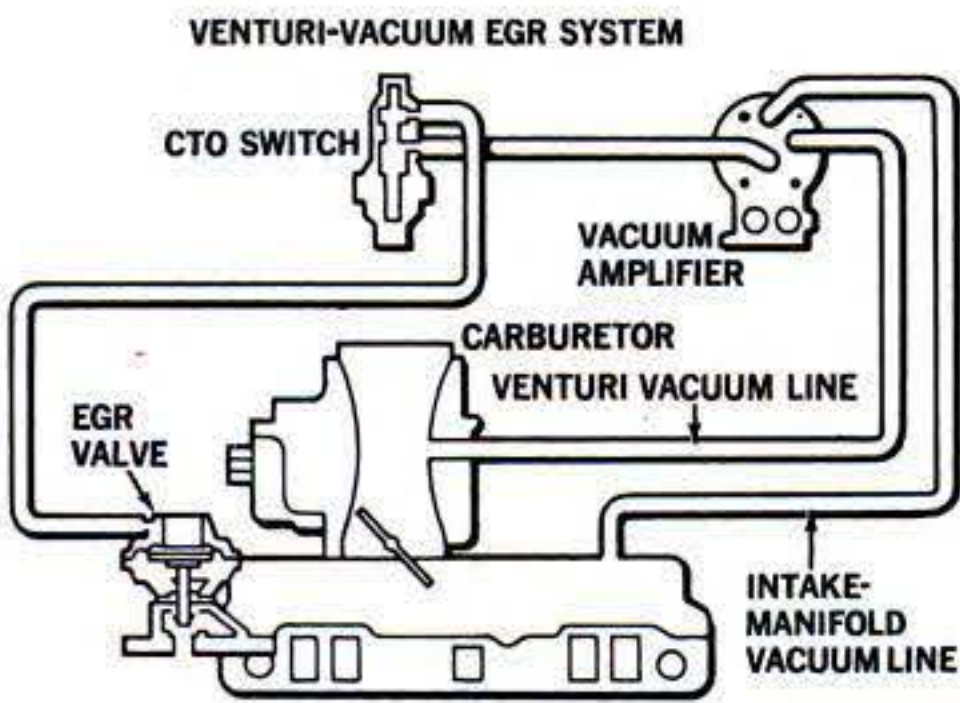
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[Continued]

creases and venturi vacuum also increases. This triggers the vacuum amplifier and lets manifold vacuum reach the EGR valve (providing, of course, that the CTO switch is open—it doesn't allow vacuum to pass through until the engine coolant has reached operating temperature).



If the EGR valve is operating at idle, as it is here, then the vacuum amplifier has to be at fault because it is the "door" between the intake manifold and the EGR valve.

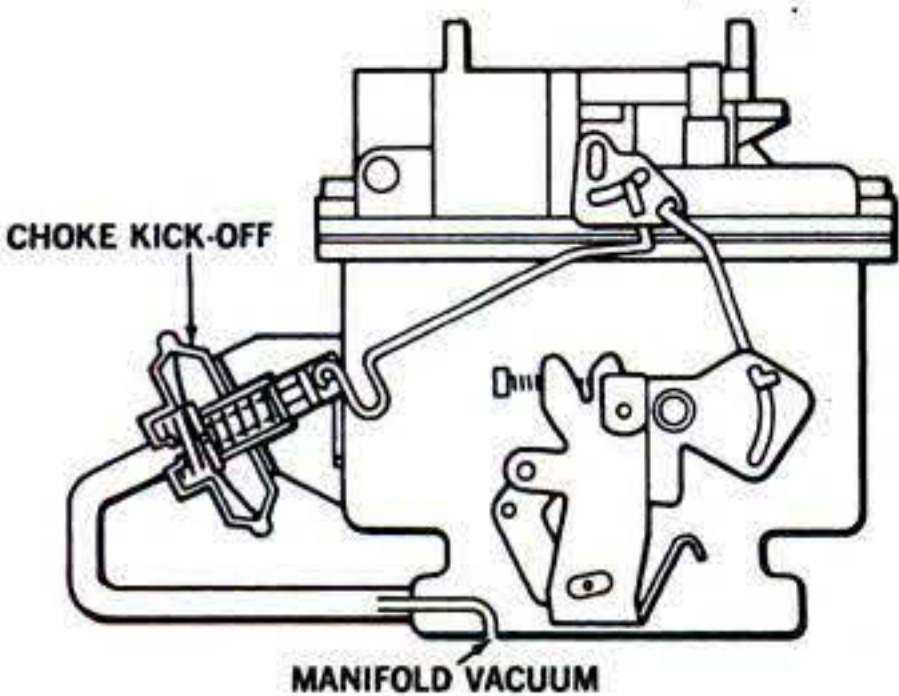
How do you know the EGR valve itself wasn't stuck open? Because when you disconnected the vacuum line to the EGR valve, the engine ran fine—which meant that the spring-loaded valve closed when the vacuum source was removed.

4 The choke kickoff is bad. It must be replaced.

The purpose of the choke kickoff is to open the choke plate slightly right after the engine starts. The choke plate is still nearly closed, but enough air can get past to let the engine run well as it warms up and the choke plate gradually opens. If the choke kickoff doesn't pull the choke plate slightly open after the engine starts, the engine will run too rich because it can't get enough air. As a result, engine performance will be poor and black smoke will come out of the tailpipe—until the engine warms up.

5 Bad valve seals are causing the problem. They must be replaced.

Continued



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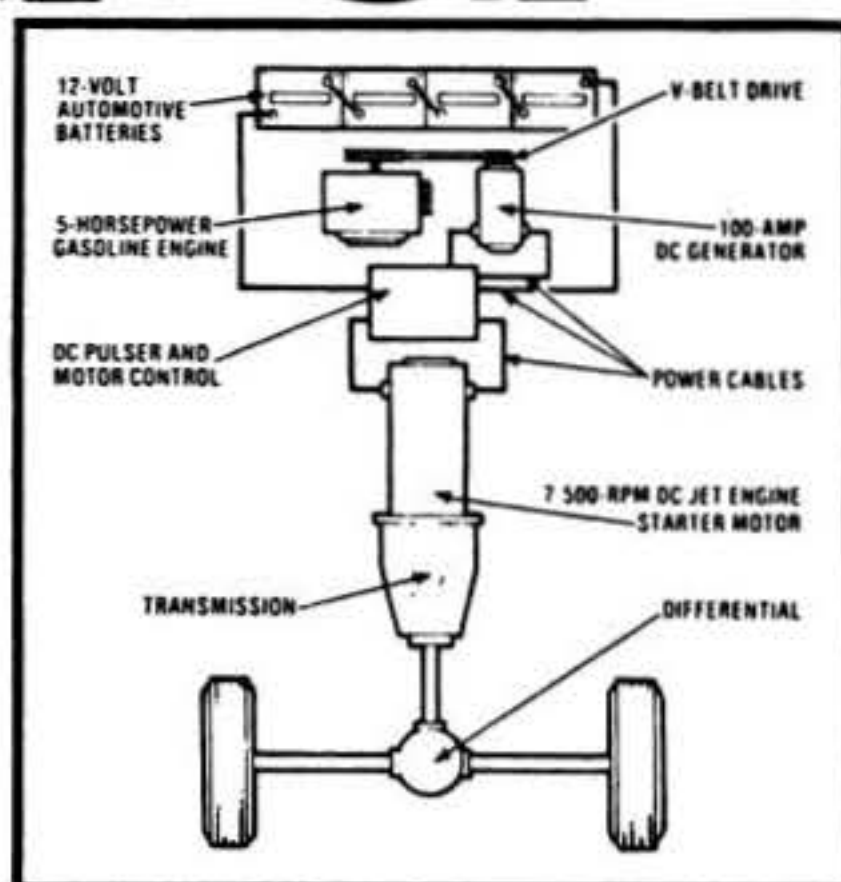
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The layout of the new drive system.

Automotive quiz

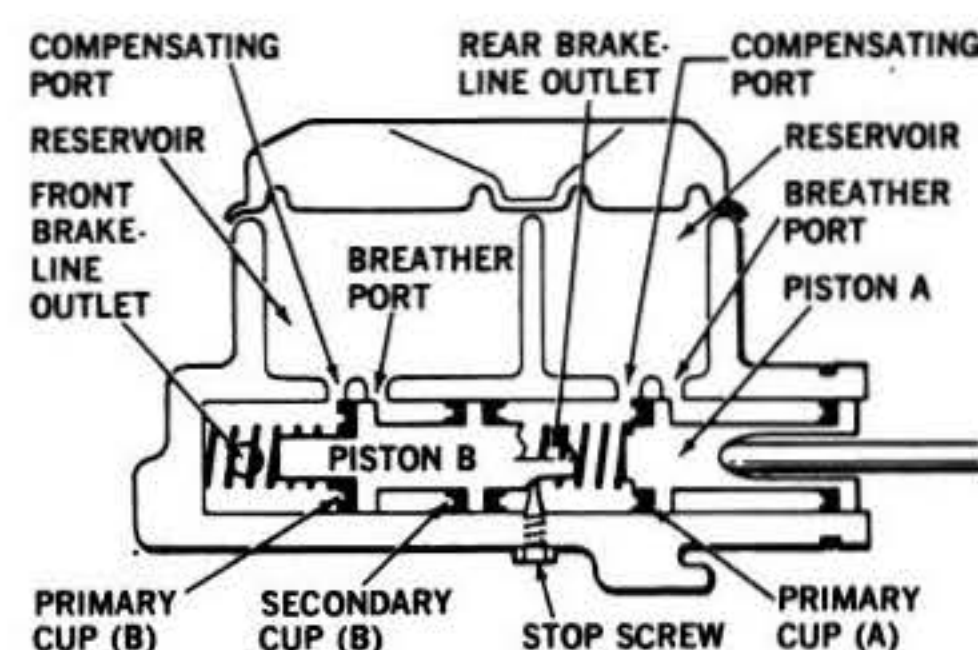
[Continued]

Vacuum, compression, and cylinder-leakage tests all indicate the engine is sealing and pumping well. Yet you're still using a lot of oil.

The tip-off to the bad valve seals is that after the engine has not run for several hours, blue smoke comes out of the tailpipe at start-up. Carbon deposits on the spark plugs confirm this. Worn valve seals are letting oil down between the valves and valve guides and into the combustion chambers. Bad valve seals are a common problem. They can be worn, even though other valve parts may be in excellent shape.

6 The master cylinder is bad. Replace it.

When you press the brake pedal with your foot and everything is working properly, the master-cylinder push-rod is forced in. This moves primary piston A past the compensating port. The brake fluid between primary cup A and secondary cup B forces piston B forward.



Pistons A and B seal off their compensating ports simultaneously—applying pressure to the brake fluid in the lines to the brake shoes or pads. But if one of the primary cups develops a leak, the result will be a fading brake pedal.

Let's say primary cup A is leaking. When the brake pedal is pushed in, piston A will go past the compensating port. But instead of forcing piston B forward hydraulically, fluid will seep around primary cup A. Piston B won't move until piston A makes physical contact with it. This, then, is perceived as a fading pedal. And stopping distances will indeed be greater, because you're not getting the hydraulic force that you would normally get (in this example) to the rear wheels.

A master cylinder that's leaking internally can be repaired. But it's common practice to replace a bad master cylinder with a new one because the cost isn't great enough to justify the tedious labor involved in repair. **[E]**

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HOW CAN WE DO IT?

Six years of experience helps. Plus a lot of ingenuity, aggressive research and a personal commitment to give our customers the best we can.

UTP Ion Research Center is a branch of our educational publishing company. And our commitment in publishing to give birth to new ideas and methods that enrich humanity is part of the Ion Research Center too. We're in business to serve you and your environmental needs.

WHAT ARE IONS?

Ions are electrically charged atoms in the air with either a positive or negative charge. The sun and cosmic rays as well as lightning and fast-moving water (like waterfalls, surf) generate trillions of negative ions every day. The more negatively ionized the air, the fresher and more alive it is. Air pollution, artificially controlled climates (with air conditioning and heating) and electronic equipment all produce excess positive ions, depriving the air of these small negative air ions and creating dead "stuffy" air.

WHAT'S THE SOLUTION?

Our rapid-growth technology, which sometimes takes its toll on the quality of our air, has also come up with the solution. Following Nature's model of the thunderstorm which uses a high electrical charge to purify, revitalize and stimulate the air, the UTP Air Energizer has been developed imitating this process. Both the thunderstorm and the Air Energizer fill the air with negative ions, restoring the natural electrical balance to the polluted, energy-depleted air. But the Ion Fountain can be used indoors in the home, office, workshop, laboratory, etc., keeping a fresh supply of ionized oxygen available night and day. This new breakthrough in fresh air control is not a cover-up

which masks or deodorizes. The unit actually removes the dust, smoke, bacteria and pollen particles from the air by attaching ions to them and causing them to sink to the earth where they can be vacuumed up rather than inhaled. At the same time ions electrically stimulate the energy-stripped air.

YOUR CHOICE OF TWO TOP-QUALITY UNITS!

There's only one unit that's better than the Ion Fountain. That's our own Executive System FourTM. It sells for \$159. It has an even higher ion output. Plus! Our special **Dial-An-Ion** feature allows you to adjust the ion output anywhere from low to high. Not everyone knows that the need for ions varies. A large smoky room will require higher output than a small room. And some people want fewer ions while sleeping than while working. The new Executive System Four is our answer to this need for output flexibility.

FACTS YOU NEED TO KNOW The Ion FountainTM—System Five

<i>Ion density:</i>	430,000 ions per cm ³ /sec. at 1 meter. 1.55 million ions per cm ³ at 50 cms.
<i>Use:</i>	Large room or office—9000 cu. ft.
<i>Warranty:</i>	1 year
<i>Output voltage:</i>	15KV
<i>Ozone:</i>	Less than 2 parts per billion
<i>Dimensions:</i>	5 $\frac{3}{8}$ " x 4 $\frac{1}{4}$ " x 2 $\frac{3}{8}$ "

Executive System FourTM

<i>Ion density:</i>	Low to maximum of 540,000 ions per cm ³ at 1 meter. 1.6 x 10 ⁶ ions per cm ³ at 50 cms.
<i>Output voltage:</i>	15KV
<i>Ozone:</i>	Less than 2 parts per billion
<i>Dimensions:</i>	11" x 5" x 4"
<i>Use:</i>	Large room or office 10,000 cu. ft.
<i>Warranty:</i>	1 year

If the Executive System Four is better, why did we bring out the Ion Fountain? Not everybody is willing to pay \$159 for an air ionizing unit, no matter how good it is. Just like not everyone drives Rolls Royces. Most drive less expensive cars. The Executive System Four is for the person who wants the

absolute best quality and doesn't mind paying a little extra to get it. If you want highest ion output, flexibility, and a beautiful oak paneled case, buy the Executive System Four.

If you want something at half the price of the Executive System Four, but still better than any other units costing up to \$250, buy the Ion Fountain.

HOW TO GET ONE

To place your order now just send a check for \$79.95 plus \$3 shipping for the Ion Fountain. Or send \$159 plus \$4 shipping for the Executive System Four. Tell us your full street address as we cannot ship to Post Office boxes. (California residents add 6% sales tax.)

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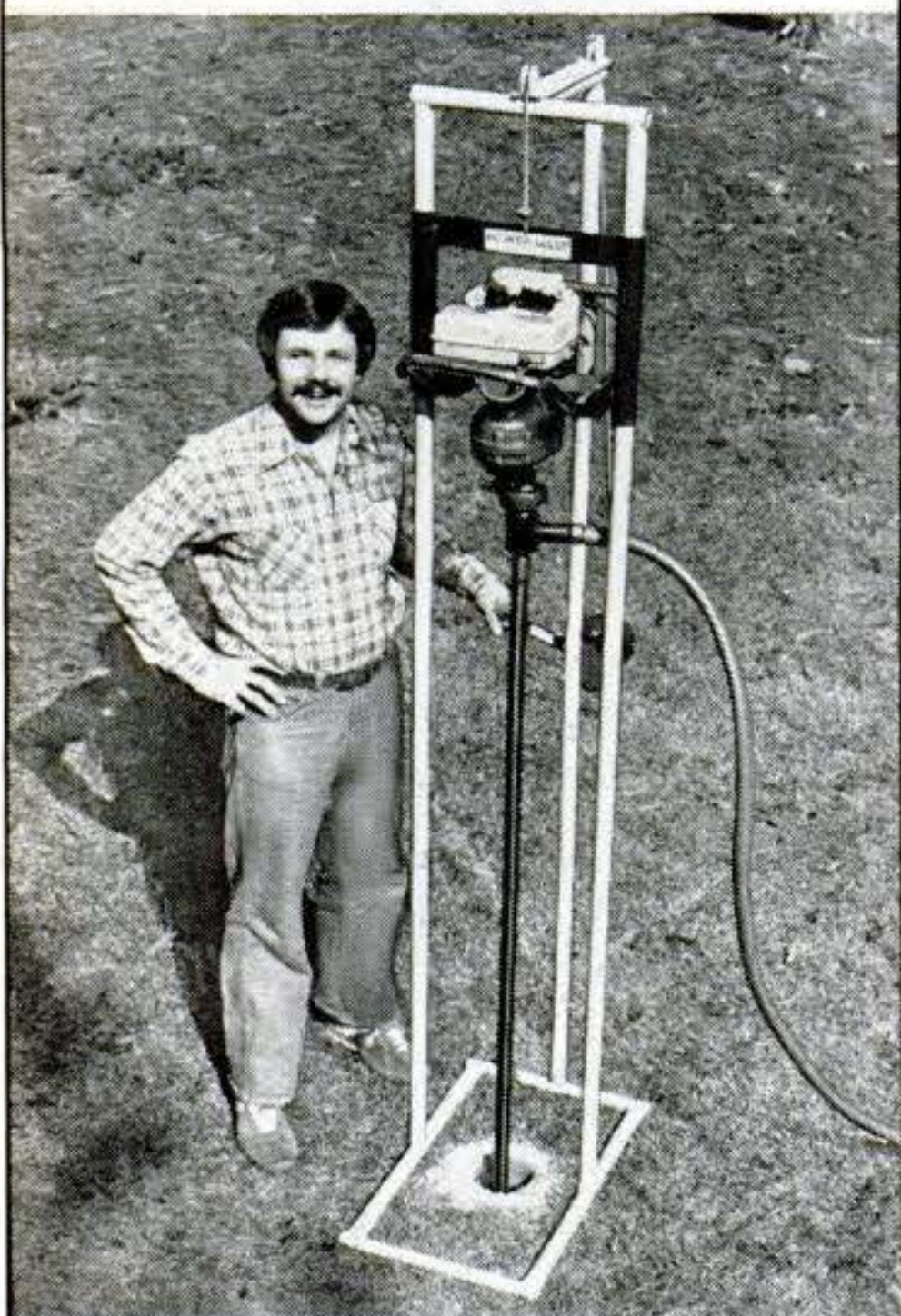
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Supersonic car

[Continued from page 91]

Flats, Utah. On Sept. 9, Barrett broke the existing land speed record by hitting 638.637 mph.

That was without Sidewinder boost, but it turned out to be a rough ride. Little ripples in the Bonneville surface were too much for both car and driver, and Barrett suffered neck and back strains from the vibrations. So the team moved to Edwards AFB in the Mojave Desert.

One trial run in December was a near tragedy. Flaws in the engine nozzle were the culprit. When Barrett ignited his rocket, the 5400-degree exhaust temperature burned away part of the nozzle. The car fishtailed across the desert at nearly 400 mph from the asymmetrical thrust. But Barrett kept the car moderately in line.

On the first try for the sound barrier, nothing happened when Barrett hit the start button. A valve had cracked, blocking fuel flow. It took a day to replace the valve.

Mach 1 on wheels

For the next try, computer analysis showed the car's fuel and the Sidewinder would be exhausted after 10,800 feet. That should be the instant of maximum speed. Crews backed up the rocket car to that distance from the speed trap, counted down, and Barrett blasted away. Midway into the run, he lit the Sidewinder.

But the computer was wrong. He ran out of fuel at 9900 feet and was already decelerating when he screamed through the speed traps. But Air Force radar units backing up the run clocked the rocket car at an official 739.66 mph, unquestionably above the speed of sound.

It was done!

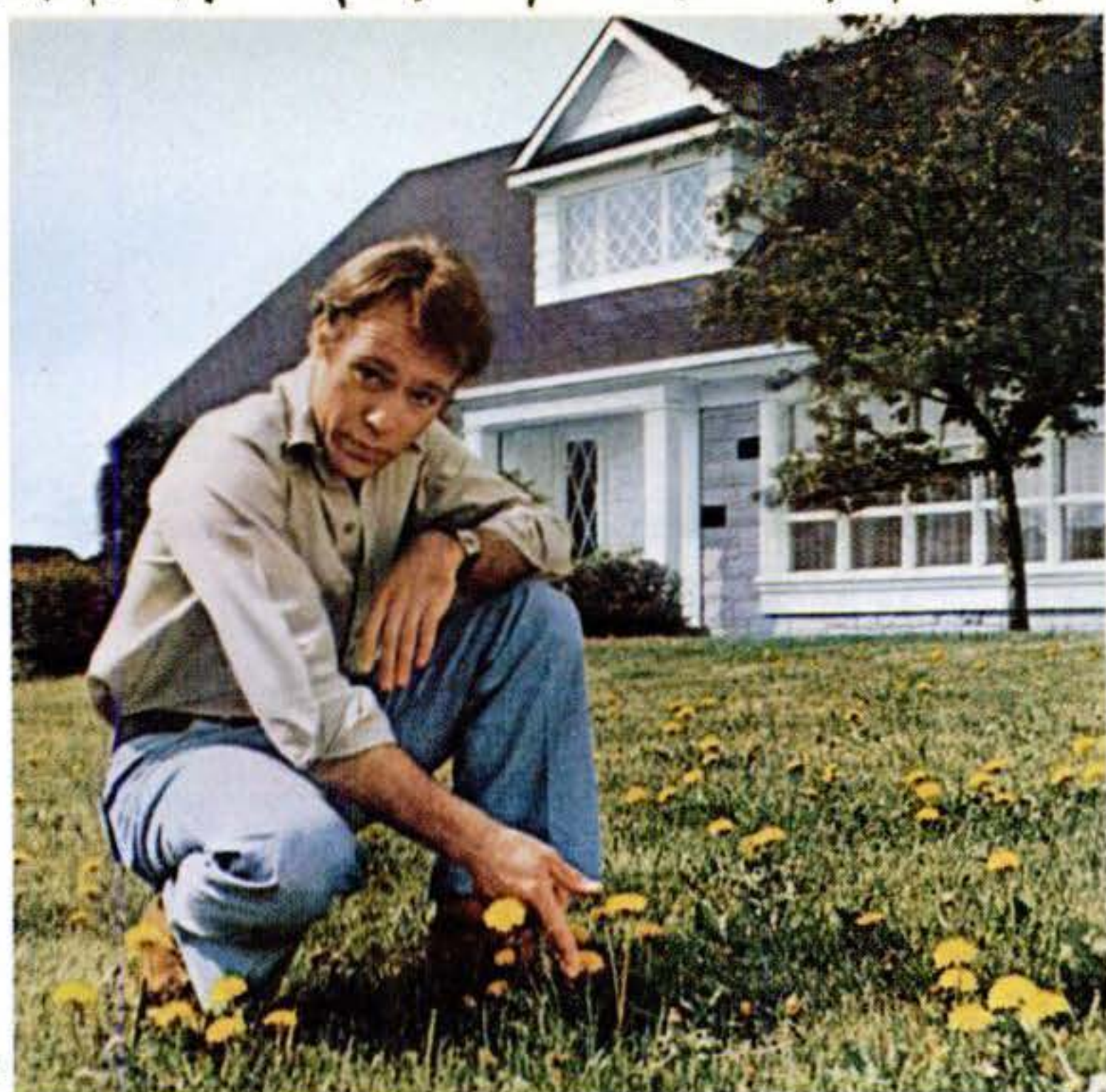
Because of the car's design, its low mass, and the diffusion of air pressure against the ground, there was no sonic boom. Observers near the point of maximum speed heard only a rumbling thunder.

Fredrick was ecstatic. His car had succeeded. "I'm only in it for the satisfaction of doing it," he said with obvious satisfaction.

There may be commercial implications for the voluminous data recorded every step of the way. Fredrick expects to use his engine in more movie stunts and thinks some of his findings may apply to helicopter research when rotor-blade tips can reach transonic speeds. And he's already thinking about the next record to break.

The water speed record is 287 mph, he said. "I think we can go 300 or even 400 mph," he grinned. "It's worth a try."

P 5



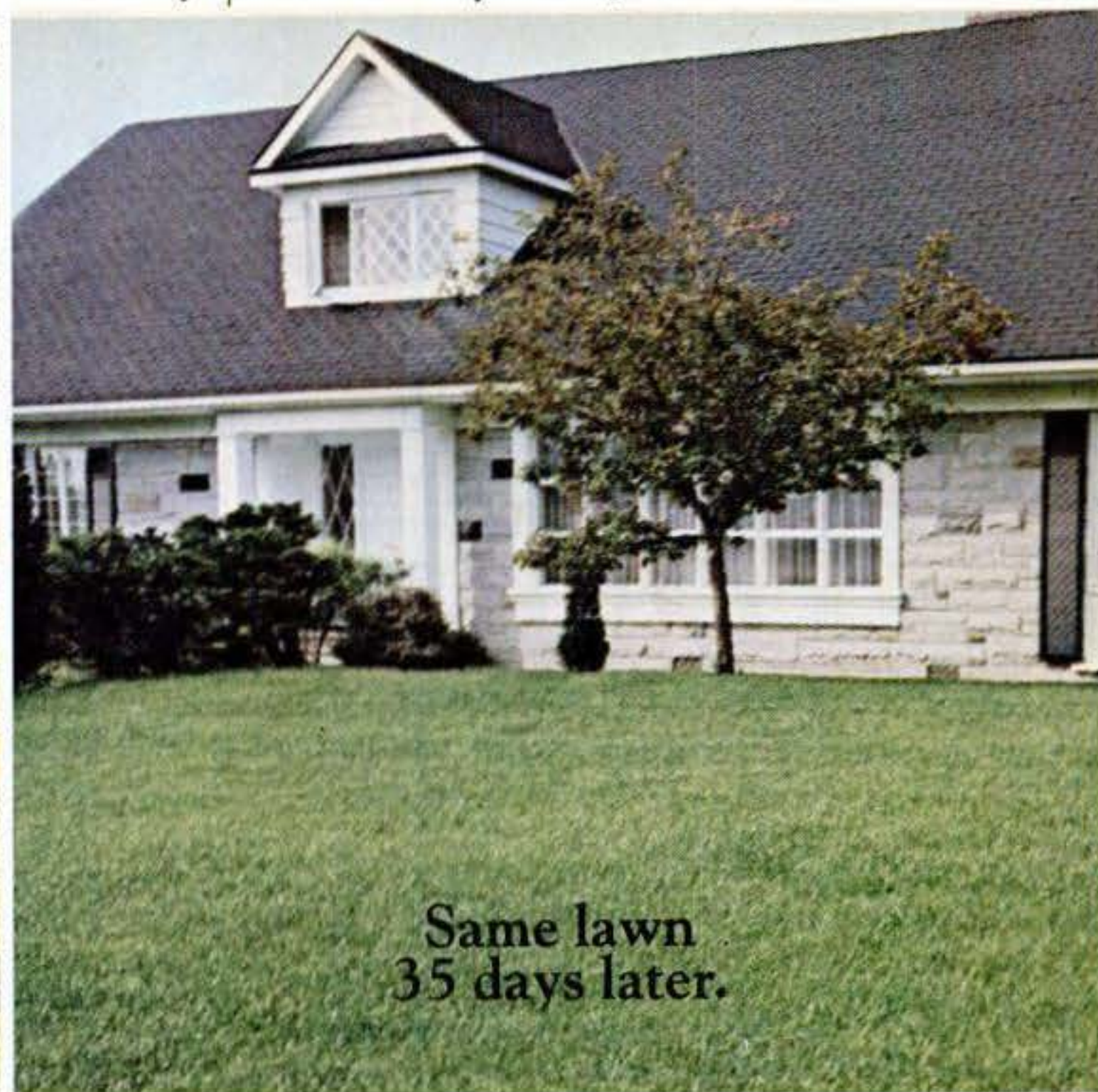
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Dandelions are a real problem. They can have roots up to two feet long. And if you don't get rid of every last bit, they just grow back.

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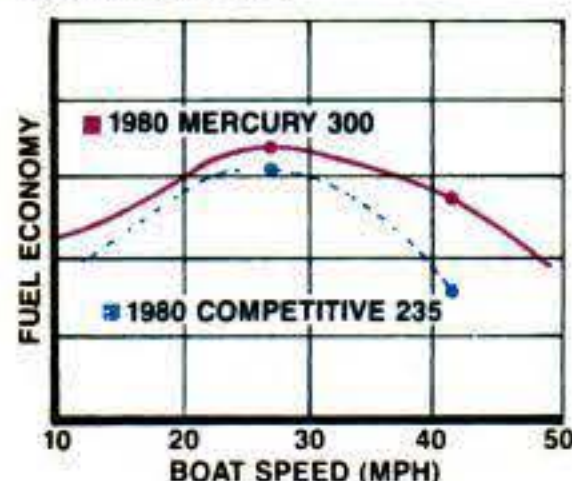
300 HORSEPOWER.

For 1980, Mercury announces the most advanced outboard ever engineered.

The 300-horsepower Mercury has arrived. And this is no supertuned, small-block outboard. The Mercury 300 is 207 cubic inches of tough, dependable power in an advanced, new V-6 design.

UNPARALLELED FUEL ECONOMY

Despite the size and power of the Mercury 300, its advanced efficiency offers substantial fuel savings over smaller V-6 competition.



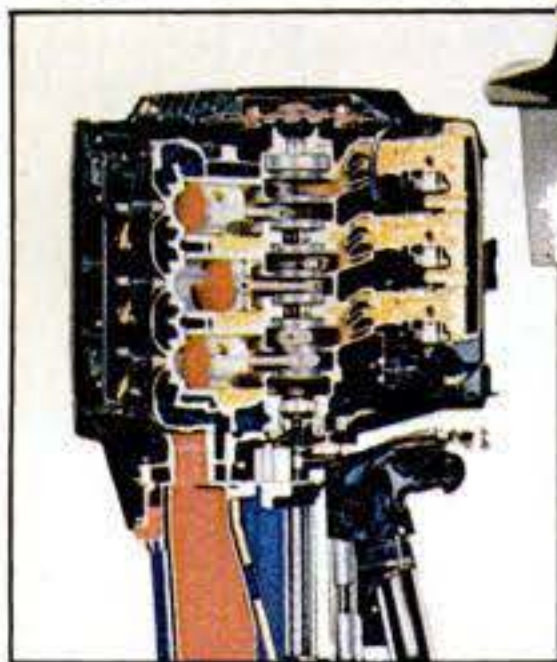
Tested at optimum cruising speed for each engine, the Mercury 300 delivered 14% better mileage than the competitive 235. And at the 235's

top speed, the 300 cruised along at 75% greater fuel economy.*

AN ENGINEERING TRIUMPH

The Mercury 300 is the first, high-horsepower production outboard to employ automotive-type sandcasting technology — a breakthrough in outboard dependability.

The sandcast V-block is the only outboard powerhead that is completely surrounded by a water jacket ... from the top of the cylinders to the bottom. As a result, the Mercury 300 runs cooler and will last longer than conventional engines.



Sandcasting: designed-in dependability.

Sandcasting also makes possible an integral exhaust system in an outboard engine. This "cast in" exhaust eliminates the need for gaskets and thus prevents water seeping into cylinders and causing engine failure.

The advantages of sandcasting are employed in all major components of the Mercury 300 — the block, cylinder heads, crankcase and driveshaft housing. For salt water service, sandcast components and advanced corrosion protection make the Mercury 300 the most seaworthy outboard ever engineered.



ADVANCED, NEW ENGINE COOLING SYSTEM

For the 300, Mercury has engineered a low-pressure, high-volume cooling system. The water pump housing is stainless steel, not plastic. Even if the water inlet is blocked when the 300 is running at high speed, the stainless steel housing will dissipate heat and the impeller will not be damaged as with ordinary systems. This stainless steel pump housing will outlast 10 ordinary housings.

BREAKTHROUGH IN HANDLING

Mercury engineers have developed a remarkably simple system to steer the 300. It's called HydraSteer™

The HydraSteer system rotates the trim tab of the engine to let water pressure "power-steer" the 300.



The Mercury 300 HydraSteer System.

Steering torque at the helm is dramatically reduced, so sheer muscle is not required to turn the 300. Driver fatigue is virtually eliminated.

HydraSteer reduces steering loads on all components in the entire system for safer, more dependable operation.

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MERCURY 300 SPECIFICATIONS

horsepower	300
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MERCURY OUTBOARDS

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Compact V6 stern-drive

[Continued from page 95]

performance with each drive. The performance curves shown on page 95 give the results of OMC's tests. Specifications for both engines appear below. Because of all the variables, few marine-engine makers issue fuel-consumption figures, but test estimates in the two identical installations indicate that from about 18 mph (base planing speed) to 40 mph, fuel consumption was apparently the same. Over 40 mph, the OMC V6 had the edge, and this rose to more than 10 percent at 48 mph.

Guy Payne, chief engineer for OMC stern-drives, says the exceptional fuel economy of the V6 is assured by the volumetric efficiency of its short-passage intake manifold and crossflow head design. The inlet manifold was designed specifically for powering boats; it accommodates a larger two-barrel carburetor and has larger passages than the automotive engine. The carb is calibrated to run very lean without sacrificing efficiency. The new camshaft incorporated along with the inlet manifold increases the engine's breathing capacity.

To achieve the engine's very trim weight (further increasing its fuel economy), production castings of the smaller manifold and high-rise elbow have shaved 51 pounds off the Chevrolet engine. The bell housing is lighter; and replacing the cast-iron exhaust pipe with aluminum reduces its weight by two-thirds. So with a cast-iron block and head, OMC has come forth with a V6 that's 30 pounds lighter than the competition's four with an aluminum block.

Compact size for its power output is the great advantage of a V6 on smaller boats. The OMC V6 is a full 4½ inches shorter than its big-bore four-cylinder competitor, and 3½ inches narrower than OMC's 305 V8—significant for twin-engine installations. A unique wraparound exhaust manifold curves inward, so precious inches aren't lost on the sides of the engine.

Four versions will be in the hands of boat builders when you read this. **P 5**

Engine specifications

	OMC	MerCruiser
Model	"Shorty"	470
No. Cylinders	90° V6	L4
Bore (in.)	3.736	4.360
Stroke (in.)	3.480	3.750
Displacement (cu. in.)	229	224
Compression ratio	8.5:1	8.8:1
Weight with drive + pwr. steer. (lbs.)	680	710
Length (in.)	31.81	36.38
Width (in.)	24.00	22.68
Height (in.)	27.68	28.26
WOT operating range (rpm)	4200-4600	3800-4200
Gear ratio	1.77:1	1.84:1
Horsepower	170	170

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Auto Editor, *Popular Mechanics*

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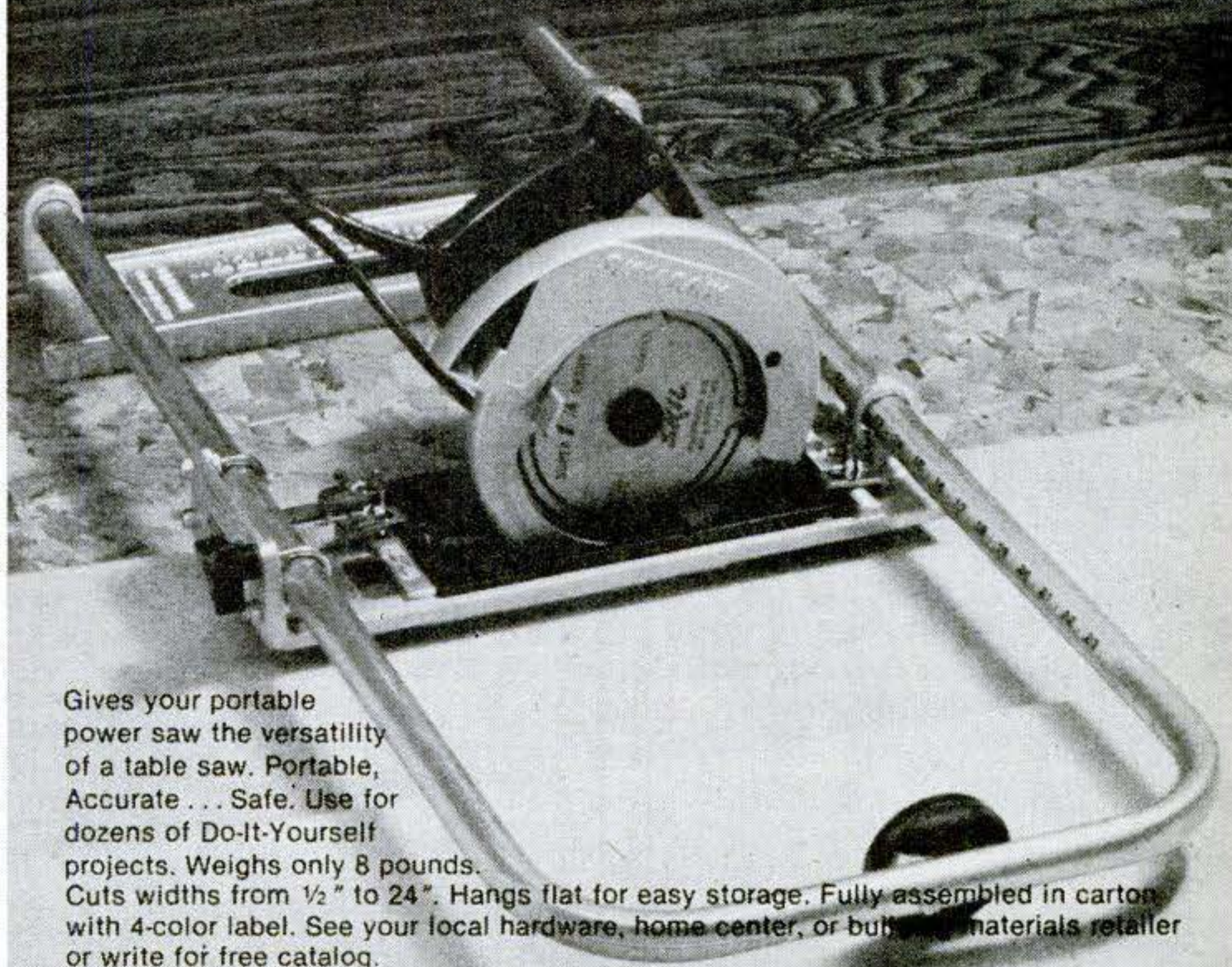
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Fiber optics

[Continued from page 103]

At these very high bit rates and bandwidths, photodetectors and transistor amplifiers as well as lasers become a problem because photodetectors and transistors begin to put out more noise. Noise can create signal errors, and although information theory provides coding and redundancy schemes to overcome noise problems, at certain noise levels complex coding becomes impractical.

There's another reason super-high telephone transmission rates may not be practical. "What if something happens to that cable?" said Li. "With one million conversations, how are you going to replace it? Diversity is important." Television rather than telephony may benefit from super-capacity fiber systems. "The advantage of the super-high rate is that you can put a lot of TV channels on it. Roughly 100 megabits for one TV channel," Li said.

He also outlined a different approach for putting more information into fibers. "There's the possibility of putting signals from two, four, or many sources onto one fiber. This is what we call wavelength or color multiplexing. You put signals at different wavelengths or color into the same fiber." This method, still under development, might be used someday, for example, to boost the capacity of the Boston-to-Washington cable system.

One of the more fascinating projects underway at Bell Labs is the development of ultralow-loss fiber material. Researchers are investigating nonsilica substances such as zinc chloride. Studies indicate a 1000-km fiber made with this substance would attenuate light only one dB. By comparison, a very high-grade silica fiber attenuates light one dB in one km. To achieve this thousandfold jump in performance, wavelengths in the 3.5-to-four-micron range are required.

How could ultralow-loss fibers be used? It's everyone's dream, said one researcher, to make a fiber with properties so that it could do the job of the transatlantic cable system, but with no repeaters. "Whether that's just a gleam in somebody's eye or not, only time will tell," he said.

FOR FURTHER READING

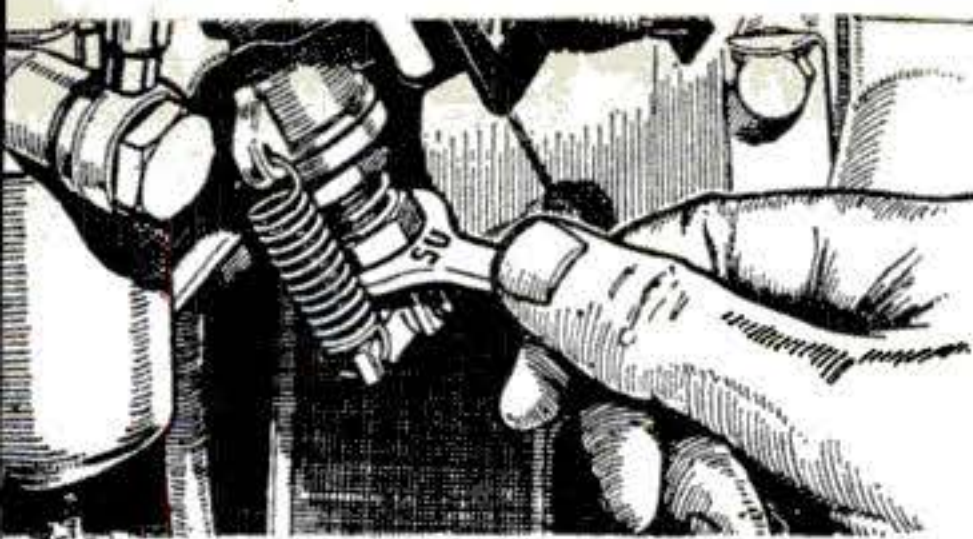
"Light-Wave Communications," by W.S. Boyle. *Scientific American*, August, 1977.

"Optical Fiber Communication—The State of the Art," by Tingye Li. *IEEE Transactions on Communications*, Vol. COM-26, No. 7, July, 1978.

Fiber Optics in Communications Systems, by G.R. Elion and H.A. Elion. Marcel Dekker, New York, 1978.

A buyer's guide to optical fibers and related hardware, with sources and technical information, is published each January by Advanced Technology Publications, Framingham, Mass. 01701. The *Laser Focus Buyers' Guide* is \$17.

Low cost optical fibers and experimental kits are available from Edmund Scientific Co., Edscorp Building, Barrington, N.J. 08007 through its catalog.



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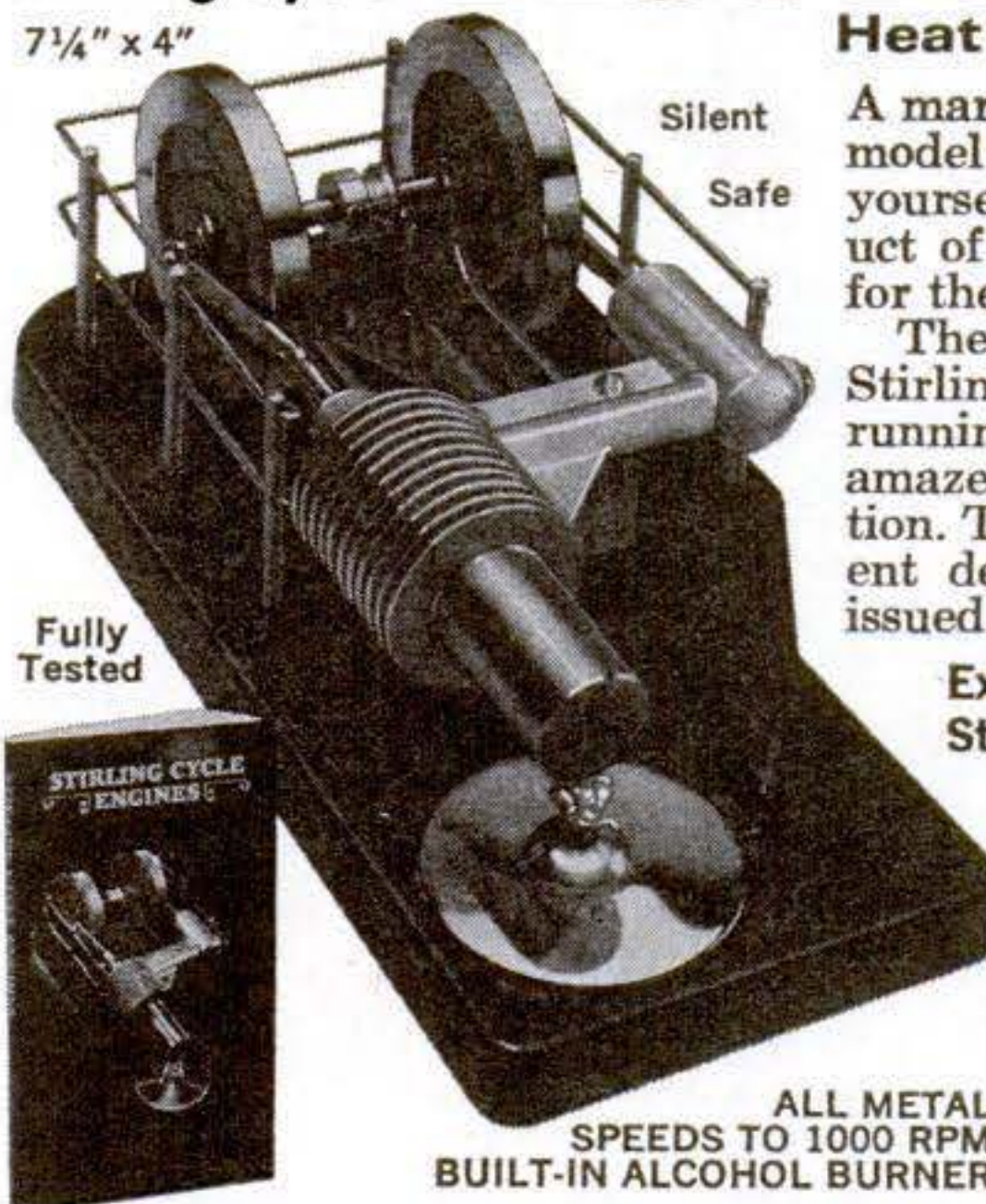
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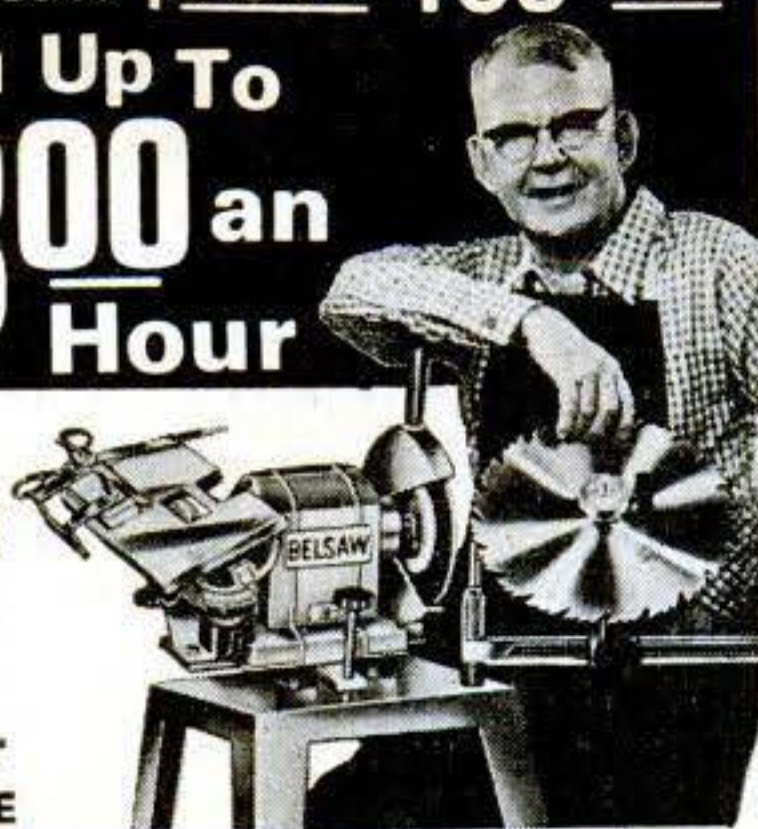
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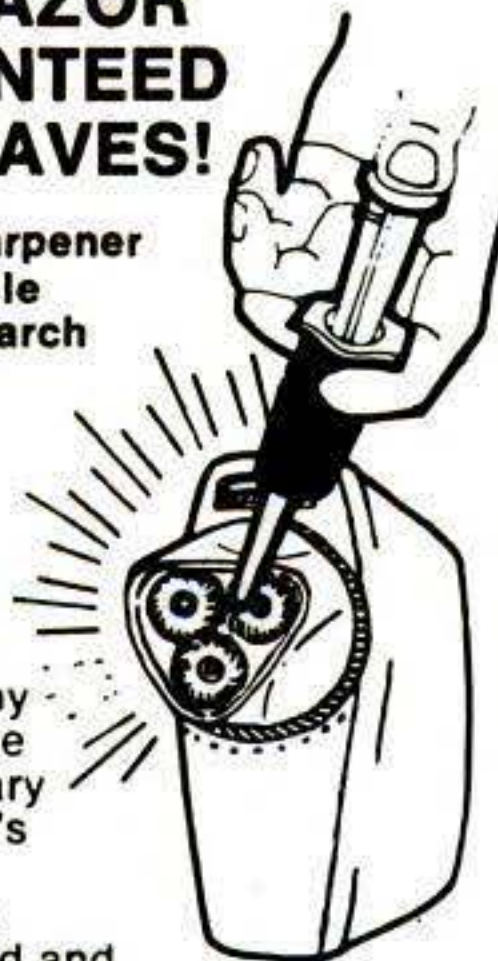
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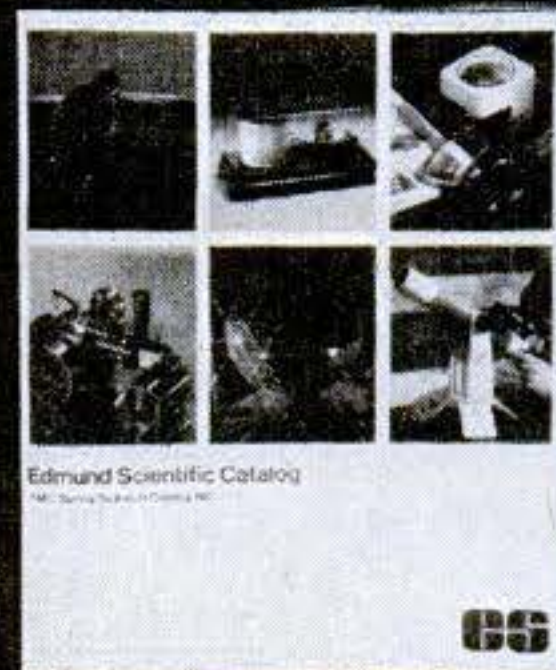
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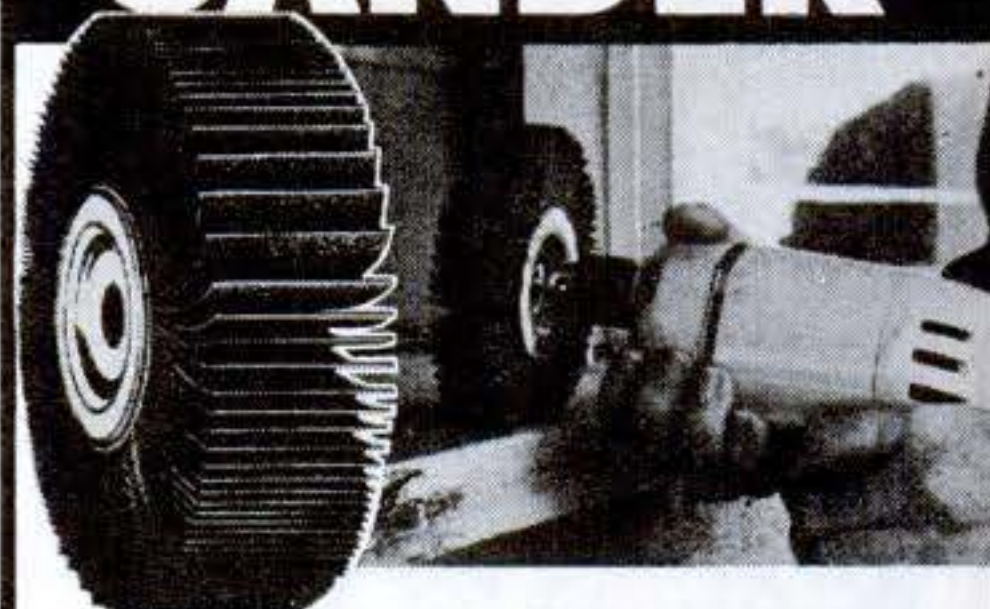
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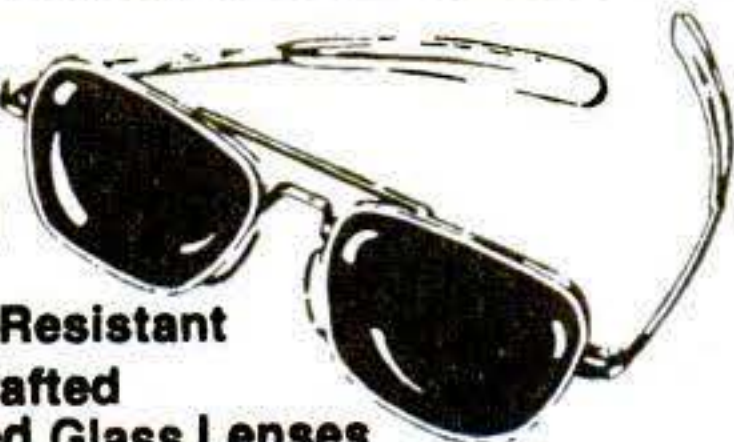
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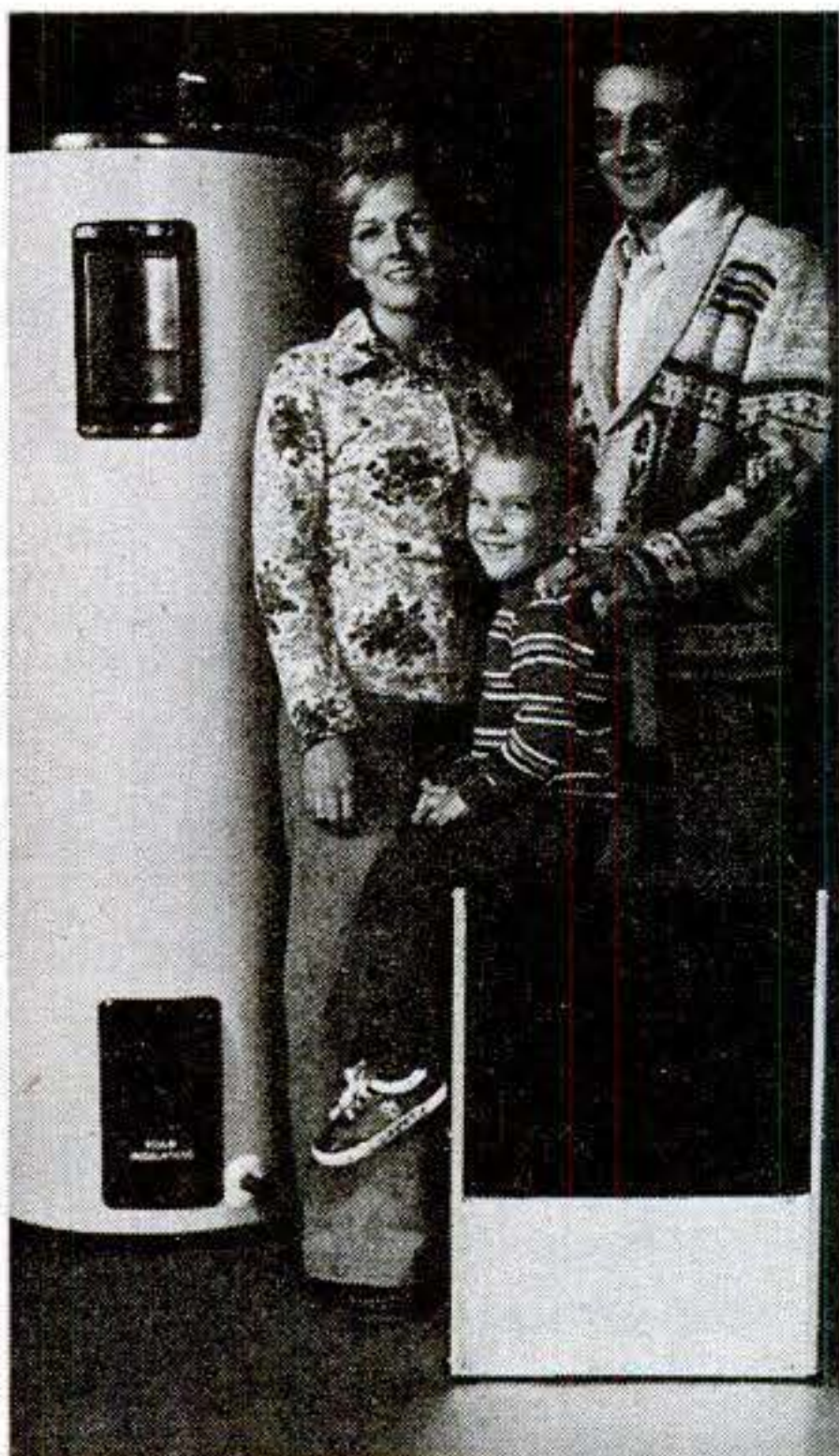
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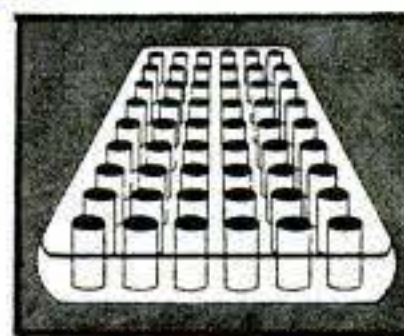
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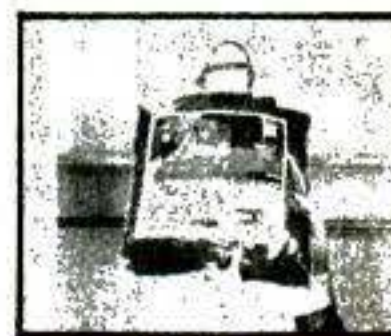
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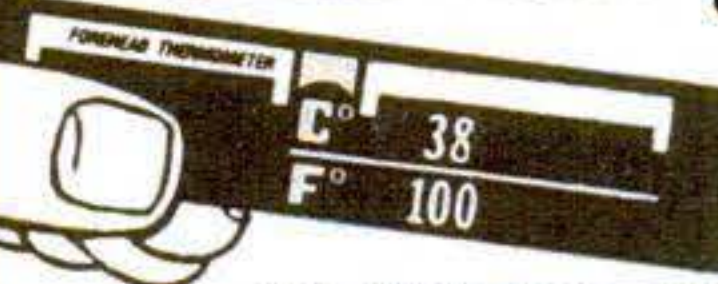
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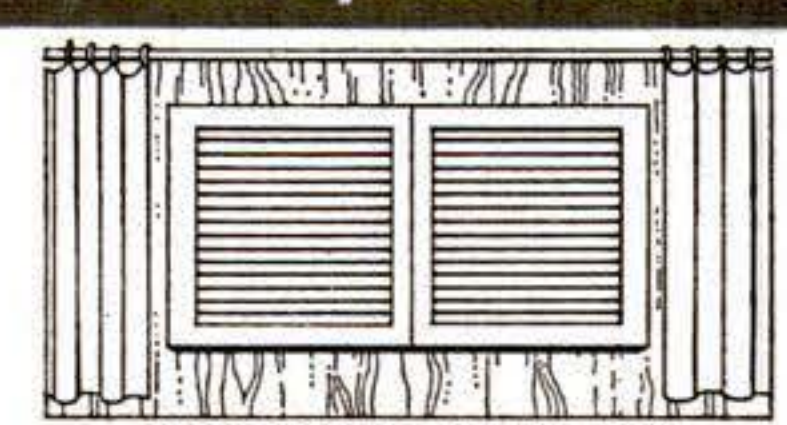
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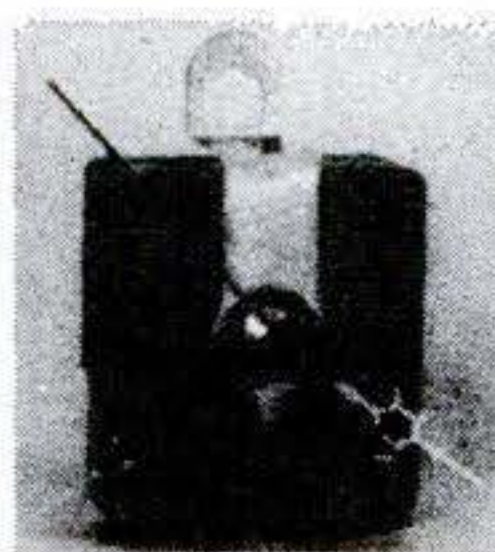
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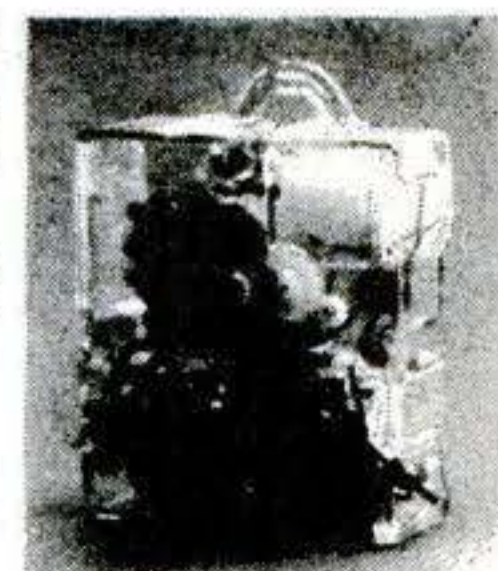
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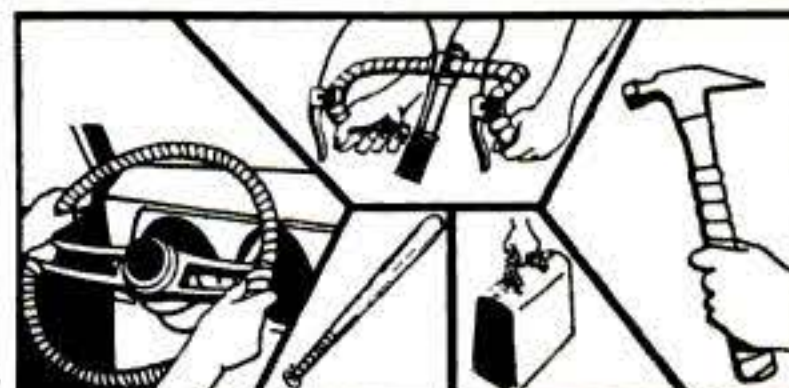
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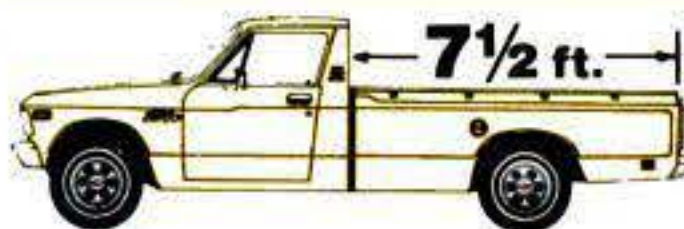
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